Report

to

GOVERNMENT OF NEW BRUNSWICK
INDUSTRIAL DEVELOPMENT SUBSIDIARY AGREEMENT
Science and Technology Secretariat
Department of Commerce and Technology
P.O. Box 6000
Fredericton, New Brunswick
E3B 5H1

VALUE-ADDED OPPORTUNITIES FOR NEW BRUNSWICK SAWMILLS

Forintek Canada Corp.

Eastern Laboratory
800 Montreal road, Ottawa, Canada, K1G 3Z5
Telephone (613) 744-0963 Telex 053-3606

88-04762/

Forintek Canada Corp., with laboratories in Ottawa and Vancouver, is a private, non-profit corporation. Its laboratories have unrivalled reputations as centers of excellence in research and development for the wood products sector of the forest industry.

Forintek's professional and support staff of 250 is actively engaged in basic and applied research in all the major scientific and technical disciplines related to wood products. These include: sawmilling, seasoning, machining, composite products, adhesives, wood-based energy and chemicals, housing, materials science, timber engineering, wood preservation, fire retardants, and the wood sciences. Forintek is a problem-oriented organization. In Canada and throughout the world, Forintek's assistance and expert advice are available to forest products industries, federal and provincial government agencies, trade associations, consultants, equipment manufacturers, educational institutions and the general public.

At Forintek, there is a committment to realize the optimum benefit from one of our most important resources, the forest.

Western Laboratory
6620 N.W. Marine Drive, Vancouver, Canada V6T 1X2
Telephone (604) 224-3221 Telex 04-508552

Eastern Laboratory
800 Montreal Road, Ottawa, Canada K1G 3Z5
Telephone (613) 744-0963 Telex 053-3606

GOVERNMENT OF
NEW BRUNSWICK

GOUVERNEMENT DU
NOUVEAU-BRUNSWICK

This publication is jointly funded
under the Canada/New Brunswick
Economic and Regional Development Agreement

GOVERNMENT OF
CANADA

Atlantic Canada
Opportunities Agency

GOUVERNEMENT DU
CANADA

Agence de Promotion
Economique du
Canada Atlantique

VALUE-ADDED OPPORTUNITIES

FOR NEW BRUNSWICK SAWMILLS

Prepared for

GOVERNMENT OF NEW BRUNSWICK
INDUSTRIAL DEVELOPMENT SUBSIDIARY AGREEMENT
Science and Technology Secretariat
Department of Commerce and Technology
P.O. Box 6000
Fredericton, New Brunswick
E3B 5H1

Prepared by

Douglas Capstick, B.Sc.F.
FORINTEK CANADA CORP.
Eastern Laboratory
800 Montreal Road
Ottawa, Ontario
K1G 3Z5

December 1987

I.D.S.A. Contract No. 9964-211-104
F.C.C. Contract No. 37-78-K-855

Douglas Capstick, B.Sc.F.
Forest Products Engineer
Lumber Manufacturing Department

Raymond Thibault
Group Manager
Primary Wood Products

TABLE OF CONTENTS

		Page
EXECUTIVE SUMMARY		v
1.0	OBJECTIVES	1
2.0	INTRODUCTION	3
	2.1 Background	3
	2.2 Shifting Softwood Markets	3
	2.3 International Competitive Position	3
	2.4 Declining Resource Quality	4
	2.5 Value-Added Concept	4
3.0	METHODOLOGY	5
	3.1 General	5
	3.2 Management and Steering Committee	5
	3.3 Economically Feasible Study Criteria	5
	3.4 Value-Added Opportunities	6
4.0	RESULTS AND DISCUSSIONS	7
	4.1 Sawmill Modernization	7
	4.1.1 Sawmill Improvement	7
	4.1.2 Industry SIP Benefits	8
	4.1.3 Modernization Strategy	8
	4.2 Improve Product Mix	11
	4.2.1 Product Mix Importance	11
	4.2.2 Agressive Marketing	11
	4.2.3 Advanced Sawmill Technology	11
	4.2.4 Industry Comparisons	12
	4.2.5 Product Mix Improvement Benefits	14
	4.3 Improve Species Mix	15
	4.3.1 Aspen Resource	15
	4.3.2 Solid Wood Aspen Products	16
	4.3.3 Processing Technology for Aspen	18
	4.3.4 Feasibility of an Aspen Sawmill	19
	4.4 Optimize Existing Planing Mill Operation	25
	4.4.1 Marketing Dressed Lumber	25
	4.4.2 Custom Planing	27
	4.4.3 Secondary Manufacturing	27
	4.5 New Markets for Short Lumber	29
	4.5.1 Background	29
	4.5.2 Marketing Impact on Profit	29
	4.5.3 Short Lumber Products	30
	4.5.4 Market Potential	32
	4.5.5 Product Alternatives	33

4.6	Installation of Dry Kilns	35
	4.6.1 Importance of Lumber Drying	35
	4.6.2 Kiln Drying Facilities	35
	4.6.3 Dry Kiln Capacity	36
	4.6.4 Equipment Capital Costs	38
	4.6.5 Operating Costs	38
	4.6.6 Revenues from Kiln Drying Operations	38
	4.6.7 Investment Analysis	38
	4.6.8 Dry Kiln Capacity	38
	4.6.9 Operating Cost	41
	4.6.10 Revenues from Kiln Drying	41
	4.6.11 Investment Analysis	41
	4.6.12 Summary	45
4.7	Secondary Manufacturing Plant	47
	4.7.1 Background	47
	4.7.2 Introduction	47
	4.7.3 Marketing Strategy	47
	4.7.4 Market Potential	49
	4.7.5 Plant Description and Capacity	53
	4.7.6 Raw Material	54
	4.7.7 Remanufacturing Products	55
	4.7.8 Product Prices	55
	4.7.9 Processing Equipment and Production Costs	56
	4.7.10 Investment Analysis	58
	4.7.11 Summary	58
4.8	Machine Stress-Rated Lumber	61
	4.8.1 Introduction	61
	4.8.2 Market Potential	61
	4.8.3 Processing Equipment	63
	4.8.4 Product Mix and Prices	64
	4.8.5 Production Costs	64
	4.8.6 Investment Analysis	68
	4.8.7 Summary	68
4.9	Dimension Stock Plant	71
	4.9.1 Introduction	71
	4.9.2 Market Potential	71
	4.9.3 Plant Capacity and Description	75
	4.9.4 Raw Material	77
	4.9.5 Dimension Stock Components	78
	4.9.6 Dimension Stock Prices	79
	4.9.7 Processing Equipment and Production Costs	79
	4.9.8 Investment Analysis	82
	4.9.9 Summary	82

APPENDICES

LIST OF TABLES

Table 1. Net Benefits from Forintek's Sawmill Improvement Program 9

Table 2. Percent Product Mix Distribution for Quebec and New Brunswick Dimension and Stud Lumber Sawmills 13

Table 3. Aspen Lumber Distribution and Prices 17

Table 4. General Information for a Sawmill Processing Aspen 20

Table 5. Profitability Analysis for a Sawmill Processing Aspen 21

Table 6. Sensitivity Analysis for a Sawmill Processing Aspen 23

Table 7. Sensitivity of Planing Mill Investment 26

Table 8. Dry Kiln Capacity 37

Table 9. Summary of Kiln Drying Investment Analysis Input Data 39

Table 10. Return on Investment and Payback Period 40

Table 11. Dry Kiln Capacity 42

Table 12. Summary of Kiln Drying Investment Analysis Input Data 43

Table 13. Return on Investment and Payback Period 44

Table 14. Value of Materials for Remanufacturing Industries 50

Table 15. Value of Materials by Wood-Using Industry 52

Table 16. Remanufacturing Plant Production Costs 57

Table 17. Sensitivity Analysis for a Remanufacturing Plant Investment 59

Table 18. Maximum Potential Market for MSR Lumber 62

Table 19. Value for Visual-Graded Product Mix 65

Table 20. Value of Machine Stress-Rated Product Mix 66

Table 21. MSR Production Costs 67

Table 22. Sensitivity Analysis for MSR Investment 69

Table 23. Value of Materials for Canadian Wooden Furniture 72

Table 24. U.S. Imports of Wooden Furniture and Parts 74

List of Tables (continued)

Table 25. Canadian and U.S. RTA Furniture Sales 76

Table 26. Dimension Stock Component Prices 80

Table 27. Dimension Plant Production Costs 81

Table 28. Sensitivity Analysis for a Dimension Stock Plant Investment 83

EXECUTIVE SUMMARY

1.0 The Value-Added Concept

Existing manufacturing and marketing strategies employed by most of the Canadian sawmilling industry will require change to remain profitable in future market conditions. Canadian production strategies emphasize maximum lumber volume recovery to reduce production costs. This philosophy is not enough to successfully compete in the international marketplace of today.

Most Scandinavian producers and a few North American softwood sawmills employ a much different marketing and manufacturing approach to solid wood products. Value maximization in combination with quality control formulate the underlying philosophy in production decisions. These successful softwood companies are able to obtain improved levels in merchandizing and develop specialty markets to increase both product volume and value.

For the Canadian sawmilling industry to remain competitive in the future, it must not only modernize its conversion technology, but also upgrade and diversify its product mix and introduce a value-added manufacturing and marketing strategy by developing and promoting new, as well as existing product lines.

2.0 Valued-Added Opportunities

2.1 sawmill modernization with respect to improving lumber volume and grade recovery, increase sawmill productivity and low capital investments to maximize overall sawmill profitability;

2.2 improve a sawmill's existing softwood product mix by analyzing the mill's product distribution with respect to lumber size, grade and price;

2.3 improve a sawmill's existing species mix by processing high quality aspen and hardwood sawlogs;

2.4 optimize an existing planing mill operation by purchasing white pine and low-priced softwood lumber considering planing mill capacity purchased lumber prices and associated higher production, inventory, overhead and transportation costs to determine breakeven lumber price differentials;

2.5 identify new product markets for short softwood lumber through aggressive marketing and secondary manufacturing, respectively;

2.6 investigate the installation of dry kilns to better market softwood studs and short lumber and kiln-dried white pine which will enable a sawmill to diversify into secondary manufacturing;

2.7 build a remanufacturing plant to produce higher-valued products by resawing, moulding, multi-saw trimming, and simple lumber defecting (cross-cutting and ripping) from dry softwood, white pine and hardwood lumber;

2.8 sort and grade stamp machine stress-rated (MSR) lumber for the building construction industry, and

2.9 build a dimension stock manufacturing plant to be able to produce finger-jointed lumber and/or semi-finished furniture components.

2.1 Sawmill Modernization

Inefficient sawmills cannot afford not to invest in sawmill improvement. A sawmill improvement program is designed so that the highest identified return on investment with the lowest risk factor involved will finance the next most beneficial investment. This sawmill modernization process continues until a mill is operating at maximum conversion efficiency.

Once the sawmill is in a better financial position, the mill owner has the option to modify and/or expand the existing sawmill design to a more profitable sawmill processing system or vertically integrate in a forwards direction towards dry kilns, remanufacturing or secondary manufacturing. One must always keep in mind that for all of the selected manufacturing and/or marketing opportunities for added value, economy of scale will greatly enhance the feasibility of the investment.

Although lumber in the rough, green condition represents the lowest product value possible, the value-added concept must commence at the raw material stage. A sawmill owner has the option to vertically integrate not only in a forward direction, but also in a backward direction to the available resource.

Sawmill modernization can generate the monetary benefits just as other solid wood manufacturing investments will do but without higher levels of risk. There is an increase in investment risk with a corresponding increase in capital required for the investment. Therefore, it is up to the sawmill owner to constantly evaluate return on investment against investment risk for each manufacturing and/or marketing opportunity.

2.2 Improve Product Mix

A sawmill can improve its product-line distribution with little or no capital investment requirement other than a more aggressive marketing approach to selling solid-wood products such as lumber. A mill's product mix should be continuously monitored through increased communication with its major lumber buyers. This will ensure a sawmill is producing a current product mix to obtain the maximum product value. By promoting a closer rapport with a company's clientele, a sawmill can develop a better understanding of a customer's product needs and problems. Furthermore, a mill can benefit from a quality control standpoint by this direct service or direct marketing to its larger clients.

A sawmill can also improve its existing product mix through capital investment of modern sawmill technology. New mill equipment will result in a product mix shift to larger product sizes employing thinner kerf saws, machine centers with improved sawing accuracy for lower target sizes and scanning technological advances to reduce fiber losses. However, economic feasibility and operating suitability are two important considerations that must be addressed before purchasing expensive sawmill equipment. As part of a sawmill's feasibility analysis, mill management is recommended to evaluate the existing mill design and available resource (considering both raw material quantity and quality) to ensure a successful operating suitability of any advanced sawmill technology.

Both aggressive marketing and advanced sawmill technology will result in higher product values. Industry comparisons show that Ontario and Quebec sawmills are more profitable despite processing smaller resources. Intensive marketing and, as a result, a more diverse product mix is especially notable for sawmills with close proximity to the U.S. marketplace. This dynamic marketing approach to improving product mix is progressed by economic feasibility analyzes of capital investment into advanced sawmill technology introduced from Scandinavia, United States or British Columbia.

2.3 Improve Species Mix

The available aspen resource in Wood Region #3 is able to support a sawmill capable of producing 5 MMbf annually.

In general, the available aspen resource offers little opportunity for a high lumber grade recovery to justify a slow multi-pass processing system such as a carriage/board edger sawmill. Aspen lumber prices are low compared to other hardwood species, but comparable to SPF lumber prices. Therefore, an aspen sawmill must be equipped to process sawlogs as fast as possible. A low resource and sawing cost is its only way to compensate for its low product value.

A softwood-type sawmill is the only logical processing system for aspen. A sawmill design with an ability for high productivity without sacrificing lumber volume and grade recovery is ideally suited for processing aspen. The use of twin circulars (scragg headsaws), chipping headrigs and twin bands improves aspen's future in the solid-wood lumber markets. The secondary processing equipment would include the use of thin-kerf bull edgers and band resaws.

A new sawmill with the processing equipment outlined in the above would not be economically feasible considering the limited resource supply and marginal market conditions. Therefore, an existing softwood sawmill must be considered for processing aspen for any expectation of profitability.

A profitability analysis for an existing softwood sawmill processing aspen sawlogs was investigated. The total product value (lumber, chips, chip fines, sawdust and bark) is $244 per Mbf-lumber tally. With a log cost of $127 per Mbf and an operating cost of $68 per Mbf, the resulting total production cost is $195 per Mbf-lumber tally. Therefore, gross profit is $49 per Mbf-lumber tally or a 25 percent gross (before tax) profit margin

on total production cost.

Although this gross profit margin is marginal, sawmill profitability would improve significantly with small increases to lumber price lumber recovery and log processing rate. An interested softwood mill should have little difficulty dealing with these operating parameters; however, securing a guaranteed log supply at a profitable log cost is a much more difficult problem. The available aspen resource of sawlog quality from Wood Region #3 is only enough sawlogs for 200 operating shifts per year. It is for this reason that log supply and log cost are very critical variables to the profitability of an aspen sawmill.

In conclusion, an existing softwood sawmill processing aspen can be a profitable enterprise. Sawmill profitability is extremely sensitive to the four main operating parameters and sawlog supply. Mill owners/ management must have firm control over these variables to ensure a successful value-added operation.

2.4 Optimize Existing Planing Mill Operation

Any sawmill with a pla ing mill has a tremendous manufacturing and marketing advantage over its competitors. An existing planing mill, if operated efficiently, provides a sawmill the opportunity to add value to its lumber sales in several ways:

- ease of marketing dressed lumber despite poor market conditions;
- custom planing garantees a specific profit margin, and
- secondary manufacturing in the future.

The last and probably the most important value-added opportunity that a planing mill presents is one of an eye to the future. As previously mentioned, most N.B. sawmills have planing mills. Coupled with dry kilns, a planing mill enables a sawmill company to pursue a number of secondary manufacturing products.

A sawmill without dry kilns could employ any excess production capacity of its existing planing mill to produce the following products:

- softwood pallets;
- industrial blocking;
- snow fencing;
- crating;
- garden shed stock;
- short studs, etc.

2.5 Short Lumber

The market for short lumber products and small dimension lumber is approximately 225 million board feet annually for eastern Canada and 1.95 billion board feet per year for eastern United States, respectively. Based on present consumption trends, there is a surplus of 140 million board feet annually in eastern Canada. Therefore, there exists a serious problem of market dumping for short and small dimension lumber throughout the sawmilling industry.

A common aspect of all successful sawmills has been their ability to maximize lumber value particularly this lower-valued, shorter length lumber despite poor market conditions. Their efforts have not come easy and only determination and aggressive marketing have generated higher dividends.

The following identifies existing short lumber products and small dimension lumber uses by product size and lumber grade:

- short studs;
- frame stock;
- pallets;
- prefabricated house components;
- fencing;
- shed stock;
- furring strips;
- lath;
- boxes and crating, and
- short truss members.

2.6 Installation of Dry Kilns

The installation of dry kilns is not only important for its added value to a sawmill's total product value but, also, as a forerunner to greater value-added opportunities. Once a mill is producing dry lumber, other secondary manufacturing products such as: window and door moldings and furniture components, etc., enable a sawmill to diversify in the future. Producing dry lumber will provide a mill much more manufacturing flexibility in pursuing a feasible opportunity of forward integration.

A sawmill must give this value-added opportunity a great deal of thought with respect to company direction for its long-term future. Since the installation of dry kilns will open the door to many secondary manufacturing options, it is important for a sawmill to consider realistic investment strategy at this stage. Mill management should know what products they want to market so that the dry kiln facilities will be adequate to support these long-term objectives.

A feasibility analysis was carried out to determine whether or not it would be economically attractive to install drying facilities. Two different scenarios were considered. Scenario A for drying SPF studs and shorts and white pine lumber, outlined an internal rate of return of 13.9 and 0.0 percent for Conventional Residue and Dehumidification type kiln investments, respectively, making Dehumidification less viable than Conventional Residue. The high volume of SPF short lumber limited the economic feasibility for both kiln analyses.

It is evident that a kiln drying operation is warranted for Scenario B (without SPF shorts) providing there is a market for the dry lumber. The Conventional Residue system of Scenario B produced an internal rate of return of 22.8 percent with a payback period of 4.1 years. Scenario B was much more financially attractive as a result of excluding SPF short lumber. At this time, it is recommended that this option be further investigated to eliminate the assumptions regarding market volume, market price and capital equipment costs.

2.7 Remanufacturing Plant

Remanufacturing has gained popularity in recent years as a value-added opportunity; especially for the softwood industry. Declining sawlog quality and low profit margins from shifting market demand and increasing international competition, has generated a new solid wood products sector within the softwood industry. Obtaining a higher product value from the available timber resource allows diversification from the traditional marketplace of commodity lumber.

Common throughout the remanufacturing sector is its market orientation or customized products. Companies within this sector are constantly on the look for new product lines. The market potential is greatly determined by this competitive nature to identify specialty markets.

In the case of establishing a remanufacturing plant in New Brunswick, there is no one product able to satisfy the production capabilities of a minimum economic plant size. This N.B. remanufacturing plant would have the advantage of producing several value-added products with close proximity to local or domestic markets for much of the plant's production capacity. Therefore, it is recommended that such a plant be based on the economy of flexibility.

The remanufacturing industry in eastern Canada and particularly for the province of New Brunswick offers an excellent value-added opportunity. The existing market size and steady market growth speaks well for an established sawmill or lumber wholesaler especially with the number of sawmills and planing mills with the number of sawmills and planing mills likely to remain constant. The province of New Brunswick has good remanufacturing markets based on its diverse array of secondary manufacturers at the domestic level and close proximity to the highly established furniture markets in Quebec and northeastern United States. There appears little need to pursue the available but extremely competitive overseas markets.

The largest percentage increase in growth shown by the remanufacturing industry was in the other wood industries. This sector includes: prefabricated wood building, kitchen cabinet and vanity, wooden door and window and coffin and casket industries. Previous research literature has indicated that both the wooden door and window and coffin and casket industries are actually declining. Therefore, the real growth within the remanufacturing industry is the prefabricated wood building and kitchen cabinet and vanity industries.

The market potential for the remanufacturing industry can also be derived from investigating the status of the residential housing industry and its growth trends. Wood products is still the prefer building material for housing since more than 90 percent of new single-family houses of wood frame construction.

The position of wood products is likely to continue as the dominant house building material in the short and long term future. This situtions is the result of lower costs, traditional end-uses, flexibility as a building product and increased quality control practices for wooden products.

A proposed remanufacturing plant, producing 7.6 MMbf of SPF, white pine and hardwood products, showed an internal rate of return of 32.5 percent with a payback period of 3.0 years based on a facilities cost of $1,882,500 and an operating cost of $1,228,800.

2.8 Machine Stress-Rated Lumber

Machine stress-rated lumber (MSR) lumber competes against visual stress-graded (VSR) lumber from structural grades of No. 1 and No. 2 lumber to lumber graded by appearance. With VSR lumber, there are problems with strength reliability for building architects and design engineers. This situation has resulted in severe lumber grading by the sawmilling industry and over designing by the building industry. MSR lumber enables fabrication of our wood structures at a lower manufacturing cost by using less material for the same strength properties with greater product reliability.

All this translates into a bright and expanding future for MSR lumber. A product such as MSR lumber has surfaced at a good time when sawmills are in search of new products that will add value to their company operations.

The market potential for MSR lumber is enormous! In North America, MSR lumber consumption is projected at 4 billion board feet annually with British Columbia lumber producers currently only satisfying 1 billion board feet per year and U.S. producers supplying another 1.5 billion board feet. The rest of the market, or approximately 1.5 billion board feet, presently goes to visual stress-rated lumber and structural grade lumber.

Based on a value-added price differential of $27.12 per Mbf and sawmill production of 20 MMbf annually, the internal rate of return for the MSR investment is 38.1 percent with a payback period of 1.4 years. The after tax profit margin in the first year without considering any investment tax credits is $72,240 or 17.2 percent based on a total production cost of $422,000 and a combined federal and provincial tax rate of 40 percent.

Additional reasons supporting a MSR investment are presented in the following:

- MSR lumber is a consumer-accepted product with an expanding market potential;
- the manufacturing process is simplicitic in that MSR machinery and testing equipment can be easily incorporated into the material flow of an existing planing mill;
- a MSR investment is economically viable since it is profitably resist a 20 percent market slump, and
- MSR lumber can be manufactured by finger-jointing MSR rejects and low-valued and short lumber.

Interested sawmill companies are encouraged to investigate the feasibility of MSR lumber in greater detail for their own specific operational, financial and market constraints. A mill should evaluate important variables which will ultimately determine the economics of a MSR operation.

2.9 Dimension Stock Components

The furniture industry has for the most part utilized hardwood species and some pine. However, as a result of declining supply of quality hardwoods and increasing resource costs, there has been species substitution of traditional hardwood products. Much of this species interchange has taken place in medium-price furniture where significant volumes of composite board products (with plastic or wood overlays) and softwood lumber (ponderosa, jack and lodgepole pine) have been increasing in the past two decades.

There has also been added pressures of rising manufacturing costs domestically and severe marketing competition from Sweden and third world countries to supply the low and medium-price furniture sectors. The North American furniture industry is in a state of change and seeking every cost advantage to remain viable. One such cost-cutting measure has been a recent trend for the furniture industry to utilize standarized dimension stock components in the manufacturing of their product lines. Coupled with the cost-saving move toward increased utilization of softwood lumber, there appears to be a real possibility for softwood furniture components.

SPF dimension stock is currently being used by the North American furniture industry; however, this market is small. Therefore, an integrated dimension stock plant with a sawmill company would need to supplement its resource supply with white pine and some hardwood lumber. This situation would place the dimension stock plant in a much more flexible position, as well as, increase its product value.

The best value-added product for softwood lumber is ready-to-assembly (RTA) furniture. This type of furniture is generally manufactured from lodgepole pine and has recently spread to the utilization of jack pine. There is no reason why RTA furniture could not expand to include clear SPF dimension stock components.

RTA furniture sales are approximately 4 and 12 percent in the U.S. and Canada while this market segment has obtained 40 percent of all European furniture sales. Considering the size of the North American market compared to the European market percentage, RTA is an exploding market. The commercial significance of SPF lumber able to satisfy the manufacturing and marketing requirements for acceptance as a high-valued RTA furniture or furniture component is overwhelming. Currently, the market size is $750 and $125 million dollars in the U.S. and Canada. This market has been estimated to double by 1990 as projected by a recent survey.

Despite this optimistic information, free trade has dampened the outlook for the Canadian furniture industry. The larger furniture companies in the U.S. have production efficiency over our Canadian counterparts. The immediate future for the Canadian furniture industry does not appear bright unless tariffs are dropped slowly over the course of many years. This market should not be ignored on the basis of free trade since our furniture manufacturers have closer proximity to both the Canadian and American markets. The Canadian furniture industry should strengthen over time creating excellent value-added opportunities for softwood lumber.

A proposed dimension stock plant, producing 2.5 MMbf of SPF, white pine and hardwood components, showed an internal rate of return of 40.1 percent with a payback period of 2.5 years based on a facilities cost of $2,707,000 and an operating cost of $1,802,000.

3.0 Industry Trends

In general, the forest products industry has experienced decreasing profitability in recent years! As a way to fight against a finite raw material supply, declining resource quality and cyclical lumber markets, the industry has turned to the value-added concept.

Forest products companies believe they can no longer successfully compete producing lower-valued commodity lumber products. An increasing number of Canadian softwood sawmills have embarked upon producing higher-valued specialty products. These products cost more to manufacture and require additional marketing effort and skills but are more profitable in the end.

4.0 Summary

A shift towards the concept of producing
VALUE-ADDED PRODUCTS
translates into
HIGHER CORPORATE PROFITS
and, more importantly
FUTURE SURVIVAL

1.0 OBJECTIVES

1.1 To identify value-added manufacturing and/or marketing opportunities or products for existing softwood sawmills.

1.2 To identify raw material availability for a sawmill-integrated, wood processing plant within Wood Producing Region #3.

1.3 To identify manufacturing and/or marketing opportunities to remanufacture low grade and short softwood lumber into higher-valued products.

1.4 To determine production costs for each value-added opportunity with respect to optimum size of operation, profitability, break-even points of operating variables, payback period on capital investments and corresponding rates of return.

1.5 To provide local, domestic and export market information for each value-added product.

2.0 INTRODUCTION

2.1 Background

The forest products industry is important to Canada; employing an estimated 300 thousand Canadians. In terms of employment and value-added manufacturing, it is the largest industry sector with annual shipments of $20 billion.

Recently, there has been an increasing concern throughout the industry regarding the future of solid wood products since the Canadian softwood industry now exports 70 percent of its lumber. Our competitive edge has been eroded as a result of this heavy reliance on international trade and by a contravelling duty on most of the lumber exported to the United States. Changes are clearly on the horizon for the softwood producers with respect to manufacturing and marketing of the raw material in order for them to remain viable.

There are several factors prompting change for the Canadian softwood industry. This solid wood products industry is facing structural changes brought about by shifting markets, our competitive position versus our major competitors and a declining quality of the presently available raw material supply, as well as our future forests.

2.2 Shifting Softwood Markets

The larger American markets for Canadian softwood lumber are residential construction, industrial wood products and repair or alteration markets. According to most projections, new housing demand in the Unites States will exhibit a declining trend throughout the remainder of this century. Reduction in overall demand is only part of the problem. Commodity lumber prices are declining in real dollar terms to further compound the troubles for the softwood industry.

2.3 International Competitive Position

A basic problem is that Canada is a marginal supplier of a low-valued product where price is the only effective market factor. Heavy reliance on a single geographic market and a single consumption sector within a shrinking market means that the Canadian softwood lumber producer is vulnerable. Knowing that market price is the only effective market factor in low-grade structural lumber markets, the strategy is to minimize production costs. However, Canadian product costs are projected to increase at a 2 to 3 percent annual real dollar rate while the United States' costs will average less than one percent and Scandinavian costs will not increase at all. Canadian softwood producers can no longer rely on lower delivered wood costs to provide the competitive edge over domestic producers in our export markets.

2.4 Declining Resource Quality

The quality of our resource is declining! This has come about through maximum production of the remaining merchantable volume timber. Furthermore, forest managers have tried to maintain an economic allowable annual cut by increasing growth rates of our second generation forests. However, maximizing growth rates without considering quality and wood properties (such as juvenile wood) of end use products will actually reduce the economic value of our future forests.

2.5 Value-Added Concept

Existing manufacturing and marketing strategies employed by most of the Canadian sawmilling industry will require change to remain profitable in future market conditions. Canadian production strategies emphasize maximum lumber volume recovery to reduce production costs. This philosophy is not enough to successfully compete in the international marketplace of today.

Most Scandinavian producers and a few North American softwood sawmills employ a much different marketing and manufacturing approach to solid wood products. Value maximization in combination with quality control formulate the underlying philosophy in production decisions. These successful softwood companies are able to obtain improved levels in merchandizing and develop specialty markets to increase both product volume and value.

For the Canadian sawmilling industry to remain competitive in the future, it must not only modernize its conversion technology, but also upgrade and diversify its product mix and introduce a value-added manufacturing and marketing strategy by developing and promoting new, as well as existing product lines.

3.0 METHODOLOGY

3.1 General

The study plan and methodology for this project is outlined in FORINTEK'S proposal entitled "Value-Added Products for Softwood Lumber", dated October 1987.

This study was conducted under the Industrial Prospecting Sub-Program of the Industrial Development Subsidiary Agreement administered by the Atlantic Canada Opportunities Agency and the Province of New Brunswick. It is under this agreement that the Province of New Brunswick plans "to identify products and markets for re-man operations which will lead to the establishment of at least three new plants in the Province to produce a higher value-added product".

3.2 Study Steering Committee

The management committee, responsible for final approval of this study, consisted of the following members:

- Mr. R. Cantin, Sub-Agreement Officer, Government of Canada; and
- Mr. W. Long, Trade Officer, Department of Commerce and Development, Province of New Brunswick;
- Mr. W. Crawford, Department of Commerce and Development, Province of New Brunswick, and
- Mr. G. Fawcett, President, H.G. Fawcett and Sons Lumber Co., Petitcodiac, New Brunswick.

3.3 Economically Feasible Study Criteria

The selection for each of the value-added opportunities were required to satisfy the following four (4) important criteria:

1. The required equipment or technology to produce a product be commercially available and highly developed;
2. The available resource be suitable as to both quality and quantity to satisfy the economically feasible plant size and/or size of operation;
3. The available market is able to support a viable operation and the market demand be established to the degree that will require little or no effort with respect to product development, and
4. The potential profitability must show a good return on investment or gross profit margin to warrant recommendation as a value-added opportunity.

It was essential to the study that these criteria be satisfied at all times to ensure that a practical evaluation be conducted for each value-added opportunity. Furthermore, it is hoped that each manufacturing and/or marketing product will enjoy a high probability for economic feasibility in the marketplace.

3.4 Value-Added Opportunities

Employing these important criteria, several value-added manufacturing and/or marketing opportunities were identified and first presented to the steering committee on October 19, 1987 as potentially the most attractive options. The strategy meeting with the steering committee finalized the following value-added opportunities for investigation.

3.4.1 sawmill modernization with respect to improving lumber volume and grade recovery, increase sawmill productivity and low capital investments to maximize overall sawmill profitability;

3.4.2 improve a sawmill's existing softwood product mix by analyzing the mill's product distribution with respect to lumber size, grade and price;

3.4.3 improve a sawmill's existing species mix by processing aspen and hardwood sawlogs;

3.4.4 optimize an existing planing mill operation by purchasing white pine and low-priced softwood lumber considering planing mill capacity purchased lumber prices and associated higher production, inventory, overhead and transportation costs to determine breakeven lumber price differentials;

3.4.5 identify new product markets for short softwood lumber through aggressive marketing and secondary manufacturing, respectively;

3.4.6 investigate the installation of dry kilns to better market softwood studs and short lumber and kiln-dried white pine which will enable a sawmill to diversify into secondary manufacturing;

3.4.7 build a remanufacturing plant to produce higher-valued products by resawing, moulding, multi-saw trimming, and simple lumber defecting (cross-cutting and ripping) from dry softwood, white pine and hardwood lumber;

3.4.8 sort and grade stamp machine stress-rated (MSR) lumber for the building construction industry, and

3.4.9 build a dimension stock manufacturing plant to be able to produce finger-jointed lumber and/or semi-finished furniture components.

4.0 RESULTS AND DISCUSSIONS

The identified manufacturing and/or marketing opportunities are the best selections for a softwood sawmill located in Wood Producing Region #3. The following value-added options producing higher-valued products with corresponding higher profit margins will undergo detailed financial investment analysis:

4.1 Sawmill Modernization;
4.2 Improve Product Mix;
4.3 Improve Species Mix;
4.4 Optimize Existing Planing Mill Operation;
4.5 New Markets for Short Lumber;
4.6 Installation of Dry Kilns;
4.7 Secondary Manufacturing Plant,
4.8 Machine Stress-Rated Lumber, and
4.9 Dimension Stock Plant.

4.1 Sawmill Modernization

4.1.1 Sawmill Improvement

Forintek's Sawmill Improvement Program (SIP) studies have identified various levels of profitability for similar sawmills processing a similar resource. Many times, the only difference between a profitable and an unprofitable sawmill was how each mill owner perceived "the final product".

Any measures that will increase product volume and value recovery and productivity without significantly increasing the corresponding operating cost will improve a sawmill's profitability.

Less profitable sawmill operations are stagnating with respect to sawmill modernization while more profitable mills are performing the initial phases of vertical integration or the concept of value-added.

Before a sawmill can justify large amounts for capital investment into "actual" value-added manufacturing opportunities, it is recommended that special attention be first paid to its operating efficiency. The following examples are problem areas for less profitable sawmills operating at a mill efficiency level below optimum:

- better sawlog quality entering the sawmill by decreasing sweep and crook and improving log lengths and overlengths and debarking;
- increase sawmill conversion efficiency by maximizing product volume and value recovery from the available sawlog resource;
- reduce sawing variation to obtain the lowest sawing target sizes for each machine center;
- eliminate edging and trimming problems through employee training programs to improve operator skills; and

- reduce sawmill downtime and delays to increase mill productivity through better quality control and mill maintenance.

4.1.2 Industry SIP Benefits

Table 1 presents a summary of the net annual benefits for 40 sawmill improvement program (SIP) studies conducted throughout eastern Canada. The monetary benefits identified by the SIP studies are significant!

The net benefits for all non-capital investment recommendations for a sawmill with an annual production of 20 MMbf can be anticipated at $712,000 per year. It is conservatively estimated that the non-capital investments could increase a representative sawmill's lumber volume recovery by 20 percent and productivity by 15 percent. These improved operating variables would result in a total production increase of 7 MMbf or a sales volume increase of approximately $1,775,300 annually.

In addition, there will be a lumber value improvement of 15 percent raising a company's average lumber price by approximately $38.04 per Mbf. Therefore, the net annual benefits from non-capital investments could improve a sawmill's gross profit by $35.60 per Mbf.

The same sawmill can expect $154,000 or $7.72 per Mbf gross profit from all capital investment recommendations (excluding any annual value-added investment) at an initial first year cost of $133,000. The capital investment recommendations of principally equipment modernization results in a low payback period of only 0.9 years. With proven results like these, a sawmill owner will see his gross profit margin increase by more than 25 percent above his current level with little investment risk.

4.1.3 Modernization Strategy

Inefficient sawmills must invest in sawmill improvement. A sawmill improvement program is designed so that the highest identified return on investment with the lowest risk factor involved will finance the next most beneficial investment. This sawmill modernization process continues until a mill is operating at maximum conversion efficiency.

Once the sawmill is in a better financial position, the mill owner has the option to modify and/or expand the existing sawmill design to a more profitable sawmill processing system or vertically integrate in a forward direction towards dry kilns, remanufacturing or secondary manufacturing. One must always keep in mind that for all of the selected manufacturing and/or marketing opportunities for added value, economy of scale will greatly enhance the feasibility of the investment.

Although lumber in the rough, green condition represents the lowest product value possible, the value-added concept must commence at the raw material stage. A sawmill owner has the option to vertically integrate not only in a forward direction, but also in a backward direction to the available resource.

Table 1

Net Benefits from Forintek's Sawmill Improvement Program (SIP)[1]

Sawmill Improvement Recommendation	Net Annual Benefits ($)[2]	Net Annual Benefits ($ per Mbf)
A. Non-Capital Investments		
1. Improve Lumber Size	183,400	9.17
2. Reduce Downtime and Delays	175,600	8.78
3. Edging Problems	155,800	7.79
4. Trimming Problems	114,200	5.71
5. Optimum Log Breakdown	62,400	3.12
6. Resource Merchandizing	20,600	1.03
7. Total of Non-Capital Investments	712,000	35.60
B. Capital Investments		
8. Total Cost of All Capital	154,000	7.72

[1] Based on 40 softwood sawmill improvement program studies conducted throughout eastern Canada

[2] Net annual benefits based on an annual production of 20 MMbf

Sawmill modernization can generate the monetary benefits just as other solid wood manufacturing investments will do but without higher levels of risk. There is an increase in investment risk with a corresponding increase in capital required for the investment. Therefore, it is up to the sawmill owner to constantly evaluate return on investment against investment risk for each manufacturing and/or marketing opportunity.

4.2 Improve Product Mix

4.2.1 Product Mix Importance

Product mix is important to a sawmill's profitability! Mill owners/managers are constantly facing lower quality raw material and changing market conditions which affect a mill's optimum product mix decisions. In addition, sawmill management throughout most of the province have been slow to investigate modern sawmill technology influencing product mix with respect to operational and financial constraints.

Improving a mill's product mix, like improving sawmill conversion efficiency, should be incorporated into the company's operating policy rather than viewed as a value-added opportunity. However, this report would be incomplete if the subject of product mix was not addressed. In general, most sawmills are under-managed requiring much of a mill's supervisory capabilities in the daily operating functions. Therefore, it is no wonder that proper assessment of a mill's product mix is often neglected.

A sawmill's product mix can be improved in three (3) different ways:

- aggressive marketing;
- advanced sawmill technology; and
- industry comparisons.

4.2.2 Aggressive Marketing

A sawmill can improve its product line distribution with little or no capital investment requirement other than a more aggressive marketing approach to selling solid-wood products such as lumber. A mill's product mix should be continuously monitored through increased communication with its major lumber buyers. This will ensure a sawmill is producing a current product mix to obtain the maximum product value. By promoting a closer rapport with a company's clientele, a sawmill can develop a better understanding of a customer's product needs and problems. Furthermore, a mill can benefit from a quality control standpoint by this direct service or direct marketing to its larger clients.

4.2.3 Advanced Sawmill Technology

A sawmill can also improve its existing product mix through capital investment of modern sawmill technology. New mill equipment will result in a product mix shift to larger product sizes employing thinner kerf saws, machine centers with improved sawing accuracy for lower target sizes and advances in scanning technology to reduce fiber losses. However, economic feasibility and operating suitability are two important considerations that must be addressed before purchasing expensive sawmill equipment. As part of a sawmill's feasibility analysis, mill management is recommended to evaluate the existing mill design and available resource (considering both raw material quantity and quality) to ensure a successful operating suitability of any advanced sawmill technology.

4.2.4 Industry Comparisons

As a way of demonstrating the value-added opportunity by improving a sawmill's product mix, an industry comparison was conducted. This industry comparison was performed for an average softwood sawmill in Wood Region #3 versus a mill processing a similar resource quality in the province of Quebec, but employing more updated sawmill equipment. The results are interesting.

Table 2 shows the percent product mix distributions for both a random-length dimension lumber and stud lumber sawmill since the two lumber distributions were so different. For the dimension mill comparison, the Quebec mills were able to produce a similar-valued product mix despite processing a smaller average log and a higher actual lumber volume recovery. These mills produced a significantly greater volume of 2x5 lumber for the reason that 1 - 2x5 can be resawn to 4 - 1x3 for a lumber volume overrun of 20 percent.

The New Brunswick Wood Region #3 sawmills produced too much 1x4 lumber at the expense of recovery 1x5 or 2x3 lumber at the sawmill's resaw. The recovery of 2x4 lumber was slightly lower as a result of processing 4x4 and 4x6 cants. A 4x4 cant can be resawn into 2 - 2x4 and a 4x6 cant can produce 3 - 2x4, 2 - 2x6 or 1 - 4x4 and 1 - 2x4 depending on market prices. Having this flexibility in a mill's sales mix is an advantage so long as the lumber handling and resawing cost can be justified in value-added lumber sale. Furthermore, these mills were able to saw a slightly higher volume of 2x10 lumber sold rough green for scaffold lumber.

Similarly, the Quebec stud mills were able to produce an equally-valued product mix as the New Brunswick sawmills while processing a smaller log quality. Much of this can be attributed to recovering a significantly higher volume of 2x3 lumber instead of 1x4 lumber as a result of improper resaw practices. Producing 2x3 lumber compared to 1x4 lumber resulted in a 64 percent increase in product value. Quebec stud mills, as did the dimension mills, recovered a higher actual lumber recovery even though the resource size was smaller. This increase can be attributed to more sophisticated sawmill equipment and processing strategies.

In summary, a Quebec sawmill whether producing dimension or stud lumber is able to obtain a product mix of similar value from a smaller resource than a New Brunswick sawmill. As previously mentioned, both aggressive marketing and advanced sawmill technology account for higher product values. Intensive marketing and, as a result, a more diverse product mix is especially notable for the sawmills with closer proximity to the U.S. marketplace. A smaller resource throughout most regions of Ontario and Quebec has driven the sawmills toward optimizing their product mix with their existing sawmill processing systems. This dynamic approach to improving product mix is aided by economic feasibility analyses of capital investment into advanced sawmill technology introduced from Scandinavia, United States or British Columbia.

Table 2

Percent Product Mix Distribution for Quebec and New Brunswick Dimension and Stud Lumber Sawmills

Product Mix	Dimension Lumber Mill		Stud Lumber Mill	
	Quebec	N.B. Region #3	Quebec	N.B. Region #3
1x3	6.6	3.1	3.8	2.4
1x4	6.2	9.1	3.9	10.0
1x5	2.8	2.2	0.2	-
1x6	1.0	1.0	0.2	4.1
sub-total	16.6	15.4	8.1	16.5
2x3	1.3	2.0	15.1	8.8
2x4	18.8	17.2	52.4	52.7
2x5	20.4	8.6	-	-
2x6	27.4	34.2	21.6	22.0
2x7	2.2	-	-	-
2x8	11.6	8.4	-	-
2x10	1.4	5.0	-	-
cants	0.3	9.2	2.8	-
sub-total	83.4	84.6	91.9	83.5
average product value ($ per Mbf)	309	310	255	254
average small-end log diameter (in.)	6.6	7.3	5.5	6.1
average actual lumber recovery (%)	52.9	47.0	47.8	45.0

[1] Softwood lumber prices presented in Appendix I

4.2.5 Product Mix Improvement Benefits

Advanced sawmill technology is expensive; however, the resulting monetary benefits can be enormous. In order to attempt to show the impact of improving a mill's product mix, assume a New Brunswick sawmill in Wood Region #3 could achieve a nominal lumber recovery of 50.0 percent for a dimension line and 46.5 percent for a stud line. These levels of lumber volume recovery and a 20 percent increase in productivity could represent gross monetary benefits of $744,000 and $2,570,400 annually for a dimension mill and stud mill currently producing only 35 Mbf per shift, respectively. The gross monetary benefits are based on softwood SPF lumber prices outlined in Appendix I. The annual gross monetary benefits outlined in Appendix II are significant and warrant immediate consideration as to capital investment of advanced sawmill technology.

4.3 Improve Species Mix

The sawmilling industry throughout most of the world is fully aware of the simple truth that their respective available raw material supplies are declining. Declining not only with respect to sawlog quantity but more importantly to sawlog quality.

Mill owners/managers have dealt with this relentless problem in several ways:

- clear-cut harvesting of the best cutting sites to reduce resource cost and obtain the highest quality raw material for the sawmill by allocating smaller diameter and lower quality sawlogs to pulpwood or firewood;
- modernizing sawmills with higher productive machine centers to reduce the processing costs of utilizing smaller diameter and lower quality sawlogs, and
- maximizing sawmill conversion efficiency primarily with special attention to lumber volume and value recovery, without decreasing mill productivity.

Over the years, attempts have been pursued to utilize undesirable species. Species, such as aspen, have not enjoyed the popularity of other hardwoods or softwoods. As a result of its abundance, closer proximity to transportation networks and markets and more importantly consumer-accepted products, aspen provides a real opportunity to the sawmill industry.

Aspen has several excellent physical and mechanical properties that have been only recently appreciated by the secondary wood-using industry:

- low weight to strength ratio;
- high preservative retention due to its low density;
- resistance to splitting during nailing;
- lack of odour;
- light colour and lack of grain; and
- good painting properties.

It is these properties that has enabled aspen to gain a foothold in the solid-wood market.

4.3.1 Aspen Resource

Available raw material data used to evaluate the potential of aspen utilization as a value-added opportunity, was based on a provincial overview report entitled "Study of Utilization of Surplus Hardwood Resources for New Brunswick".

Wood Region #3 has the largest and the least committed surplus of hardwood in the province. This region has an apparent available hardwood surplus of 421,700 m^3 with aspen representing approximately 55 percent or 231,900 m^3.

However, the sawlog quality for aspen is only 10 percent of the surplus volume or 23,200 m^3. This aspen surplus volume could support a sawmill capable of producing 5 MMbf-lumber tally annually. Or, a sawmill with a shift production of 25 per Mbf-lumber tally and 200 operating shifts per year could be sustained. The resource cost for aspen logs of sawlog quality is approximately $28 per m^3-net N.B. log scale or $127 per Mbf-net N.B. log tally based on a lumber recovery of 4.54 m^3 per Mbf.

4.3.2 Solid Wood Aspen Products

Standard factory lumber is graded under the National Hardwood Lumber Association rules. Most factory lumber is remanufactured and is graded on a cutting yield basis. This system of grading takes into account size, percentage yield and number of clear face cuttings or pieces that can be obtained from a board. Aspen lumber most commonly would be cut-up into such products as: furniture and pallet components.

A sawmill processing aspen logs would produce 4/4 and 5/4 standard factory lumber, landscaping ties and garden timbers. The No. 1 Common and Better lumber is used by the furniture industry, No. 2A Common lumber is marketed as framestock or industrial blocking and No. 2B and 3 Common lumber is destined to low-valued, end-uses such as: pallets, boxes and crating. Most landscape ties and garden timbers are sold to a treating plant which will chemically treat this material to prolong in-ground serviceability.

Table 3 presents an average lumber distribution and lumber prices by lumber thickness and product grade for aspen. The average lumber price for mill-run aspen lumber weighted by lumber thickness and product grade is $226.35 per Mbf-lumber tally FOB mill.

In both Canada and the northeastern United States, aspen lumber is currently not enjoying good market status especially in the lower grades. However, the treating plants are presently buying all aspen landscape ties and garden timbers and prices are good. This market is a reflection of the high number of housing starts throughout most major cities in Canada and United States in the last few years. Aspen lumber does not have any potential overseas in the export markets unless markets can be developed for high valued products such as: furniture components or lumber exports for musical instruments.

Traditionally, aspen lumber has been poorly manufactured with little quality control resulting in a poor reputation. Aspen lumber, if manufactured to high tolerances, can be successfully marketed by developing high-valued products such as: dimension stock components for the furniture industry or specialty product such as: squares for the turning industry. More importantly, successful marketing will depend upon customer satisfaction with respect to product specifications, client service and product concept securely based on aspen's desirable wood characteristics.

Table 3

Aspen Lumber Distribution and Prices

A. Lumber Distribution (%)

Thickness	No. 1 Common and Better	No. 2 A Common	No. 2 B and 3 Common	Ties and Timbers
4/4	18	7	7	-
5/4	7	3	3	-
Total[1]	25	10	10	55

B. Lumber Prices ($CDN funds FOB mill)[2]

Thickness	No. 1 Common and Better	No. 2 A Common	No. 2 B and 3 Common	Ties and Timbers
4/4	360	150	100	-
5/4	370	160	110	-
Total[1]	363	153	103	200[3]

[1] Based on 70% 4/4 and 30% 5/4 lumber

[2] Lumber prices supplied by Mr. Don Bradley, Massachussets, U.S.A.

[3] Based on $175 (US) per Mbf FOB treating plant, an exchange rate of $1.30 US to $1.00 CDN and a transportation cost of $27.50 (CDN) per Mbf.

Aspen is very similar in weight and nailing characteristics to the SPF species group and as such can be considered for construction lumber.

Construction lumber is graded by the National Lumber Grades Authority rules. The Grades are Construction and Better (No. 1), Standard (No. 2), Utility (No. 3) and Economy for dimension lumber and stud lumber. It is graded on a defect basis in which size, frequency and nature of defects govern each grade. The end-use requires material that meets certain strength criteria. The factors influencing strength such as wood density, rot and size and location of knots are extremely important.

Old growth aspen stands would not be well suited to the production of construction lumber because of its inherent high cull factors. Younger growth aspen (less than 50 years of age) could be considered for the production of construction lumber since it is smaller and sounder. This material will yield higher lumber volume and grade recoveries despite its smaller size but will require a high production softwood stud mill.

Some aspen stud lumber has been produced and marketed in the past, especially in times of high demand. Again, there is a general market resistance to aspen but this has been overcome with proper manufacturing and close quality control. Pricing of aspen studs is usually discounted compared to SPF studs to encourage market acceptance. A good example of market resistance is in selling yellow poplar. This species has met the challenge and overcome much of its problems to be marketed as construction lumber through research development, technology transfer and aggressive marketing.

4.3.3 Processing Technology for Aspen

The success of aspen as standard factory lumber, random length dimension lumber or stud lumber is very dependent upon the softwood lumber industry. An aspen sawmill must modernize proportionately to softwood sawmill technology in order to remain viable.

In general, the available aspen resource quality offers little opportunity for a high lumber grade recovery to justify a slow multi-pass processing system such as a carriage/board edger sawmill. Aspen lumber prices are low compared to other hardwood species, but comparable to SPF lumber prices. Therefore, an aspen sawmill must be equipped to process sawlogs as fast as possible. A low resource and sawing cost is its only way to compensate for its low product value.

A softwood-type sawmill is the only logical processing system for aspen. A sawmill design with an ability for high productivity without sacrificing lumber volume and grade recovery is ideally suited for processing aspen. The use of twin circulars (scragg headsaws), chipping headrigs and twin bands improves aspen's future in the solid-wood lumber markets. The secondary processing equipment would include the use of thin-kerf bull edgers and band resaws. However, this investment analysis was conducted on the basis of a softwood dimension sawmill with a circular headsaw, bull edger and band resaw. Although this processing is not the most ideal sawmill design, it does offer this investment an added degree of product mix flexibility.

A newly constructed sawmill with the high productivity would not be economically feasible considering the limited resource supply and marginal market conditions to offset the required capital investment. Therefore, an existing softwood sawmill must be considered for processing aspen for any expectation of profitability.

4.3.4 Feasibility of an Aspen Sawmill

A single-line mill consisting of a ring debarker, circular twin saw (scragg headsaw) combination bull/board edger, circular resaw and 2-saw Canadian-style trimmer was selected as a representative softwood sawmill in Wood Producing Region #3. This mill will be economically evaluated in processing aspen into standard factory lumber. The assumption to produce standard factory lumber rather than stud lumber was based on the fact that higher-valued products such as dimension stock components and pallets could be manufactured from standard factory lumber in the future. Presently, the lumber prices for both standard factory lumber and stud lumber are similar.

Table 4 presents general information summarized regarding data input into the feasibility of the value-added opportunity. This sawmill will have the capability of producing 25 Mbf-lumber tally per 9.0 hour operating shift while processing 470 logs with an operating cost of $1,700 per shift. The economic analysis was also based on the mill producing 31 percent chips and chip fines which results in a chip factor of 0.57 o.d. tons per Mbf-lumber tally. Green tonnes of chips will be sold to pulp mills. Sawdust and bark was assumed to be completely sold at an average residue price of $4.50 per net o.d. tonne.

Table 5 shows the profitability analysis for a sawmill processing aspen sawlogs. The total product value (lumber, chips, chip fines, sawdust and bark) is $244 per Mbf-lumber tally. With a log cost of $127 per Mbf and an operating cost of $68 per Mbf, the resulting total production cost is $195 per Mbf-lumber tally. Therefore, gross profit is $49 per Mbf-lumber tally or a 25 percent gross (before tax) profit margin on total production cost.

Although this gross profit margin is marginal, it is important to investigate the sensitivity of the sawmill's operating variables. The sensitivity figures can be used to assess the potential impact of changes the operating parameters on sawmill profit. It should be pointed out that the sensitivity analysis only evaluates the impact of changes in the variable studied in isolation. In other words, it is assumed that all other variables remain the same for a given change in one variable.

The following list of operating variables are in decreasing order of importance based on the aspen sawmill's sensitivity analysis:

- lumber price;
- lumber recovery;
- log cost; and
- log processing rate.

Table 4

General Information for a Sawmill Processing Aspen

Average Sawlog Volume	=	8.50 cf per log
Nominal Lumber Recovery	=	52.0% 6.24 bf per cf-logs
Chip and Chip Fines Recovery	=	31.0%
Sawdust Recovery	=	14.0%
Sawmill Production	=	25 Mbf per shift
Average Log Processing Rate	=	470 logs per shift
Average Log Price	=	$28 per m^3 or $127 per Mbf-N.B. log scale
Average Lumber Price[1]	=	$226 per Mbf-lumber tally
Chip and Chip Fine Price	=	$30 per net green tonne
Sawdust and Bark Price	=	$5 per net o.d. tonne
Sawmill Operating Cost	=	$1,700 per shift

[1] Based on aspen lumber prices outlined in Table 3.

Table 5

Profitability Analysis for a Sawmill Processing Aspen

Sawmill Parameters	$ per Mbf
Lumber Value	226
Chip and Chip Fines Value	16
Sawdust and Bark Value	2
Total Product Value	$244
Log Cost	127
Operating Cost	68
Total Production Cost	$195

Therefore, gross profit is $49 per Mbf or 25% gross profit margin.

Table 6 summarizes the sensitivity analysis for each of the four (4) main operating parameters of a sawmill processing aspen. Even though the sawmill industry is a dynamic environment, this sensitivity analysis provides the necessary information required to establish a breakeven point for this aspen sawmill. That is to say, for a zero gross profit margin, the following independent operating variables would become:

- lumber price = $178 per Mbf
- lumber recovery = 4.9 bf per cf
- log cost = $38 per m^3
- log processing rate = 275 logs per shift
- lumber volume = 14.6 Mbf per shift

The profitability for the aspen sawmill would improve significantly with small increases to lumber price and lumber recovery which any sawmill has a greater control over. Appendix III outlines a gross profit margin of 36 percent for a 5 percent increase to each of lumber price and lumber volume. Conversely, the same is true; the gross profit margin will decrease greatly if these two operating variables were to decline as shown in Appendix IV.

An interested softwood mill should have little difficulty dealing with the operating parameters of lumber price, lumber recovery and log processing rate. However, securing a guaranteed log supply at a profitable log cost is a much more difficult problem. The available aspen resource of sawlog quality from Wood Region #3 is only enough sawlogs for 200 operating shifts per year. It is for this reason that log supply and log cost are very critical variables to the profitability of an aspen sawmill.

In conclusion, an existing softwood sawmill processing aspen can be a profitable enterprise. Sawmill profitability is extremely sensitive to the four main operating parameters and sawlog supply. Mill owners/ management must have firm control over these variables to ensure a successful value-added operation.

Table 6

Sensitivity Analysis for a Sawmill Processing Aspen

Sawmill Parameter (%)			Profit per Shift ($)	Profit Margin (%)
Log Cost ($ per cf)	-30	0.555	2169	55.3
	-20	0.634	1851	43.6
	-10	0.714	1533	33.6
	0	0.793	1216	25.0
	+10	0.872	898	17.3
	+20	0.951	580	10.6
	+30	1.031	262	4.5
Lumber Price ($/Mbf)	-30	158	-482	-9.8
	-20	181	84	1.7
	-10	204	650	13.3
	0	226	1216	25.0
	+10	249	1782	36.5
	+20	272	2348	48.1
	+30	294	2914	59.7
Lumber Recovery (bf per cf)	-30	4.37	-274	-5.6
	-20	4.99	222	4.5
	-10	5.62	719	14.7
	0	6.24	1216	25.0
	10	6.86	1507	35.1
	20	7.48	1799	45.2
	30	8.11	2090	55.5
Processing Rate (logs per shift)	-30	330	1725	8.6
	-20	377	1555	14.9
	-10	424	1385	20.3
	0	470	1216	25.0
	10	518	1045	29.0
	20	565	875	32.6
	30	612	706	35.9

4.4 Optimize Existing Planing Mill Operation

Any sawmill with a planing mill has a tremendous manufacturing and marketing advantage over its competitors. An existing planing mill, if operated efficiently, provides a sawmill the opportunity to add value to its lumber sales in several ways:

- marketing dressed lumber;
- custom planing, and
- secondary manufacturing.

4.4.1 Marketing Dressed Lumber

Any form of additional manufacturing will result in an added value to the final product. In this case, dressed lumber for the commodity market generally commands a higher lumber price than rough lumber. Therefore, a sawmill's gross profit margin will increase based on an ensured percentage of profit on a higher production cost.

Our sawmill studies have shown a planing cost of $22 per Mbf which represents approximately 7.7 percent of the mill's average lumber sales price for an operation dressing an annual production of 19 MMbf. As a result, a sawmill will price its lumber at such a level as to reflect the higher production cost including a generous mark-up for planing. The value-added for production planing generally nets a minimum profit margin of 60 percent on production costs or approximately $13 per Mbf. Therefore, a sawmill requiring a planing operation to surface 19 MMbf of lumber can invest up to $418,000 annually for total operating expenses.

An economic feasibility analysis for a planing mill investment of $300,000 was conducted based on the following operating variables:

. planing mill capital investment	$300,000
. variable costs	$250,000
. fixed costs	$100,000
. overhead and administration	$ 50,000
. depreciation	$ 20,000
. 10-year horizon	

Table 7 presents the sensitivity of this analysis on lumber price, variable cost, fixed cost and facilities cost. The resulting return on investment of a planing mill is 62.2 percent with a payback period of only 8 months. The breakeven facilities cost at a 25 percent internal rate of return is $635,000. Despite a 20 percent drop in lumber sales price for dressed lumber, the internal rate of return only dropped to 32.9 percent. This sensitivity analysis indicates that the profitability of this investment is quite resilient to unfavorable market conditions due to its inherently high profitability.

Table 7

Sensitivity of Planing Mill Investment

Investment Parameter	Percent Change in Investment Parameter (%) -20	-10	0	+10	+20
	..... internal rates of return				
Value-Added Lumber Price[1]	32.9	47.9	62.2	76.1	89.9
Variable Costs	72.7	67.5	62.2	56.9	51.5
Fixed Costs	68.5	65.4	62.2	59.0	55.8
Facilities Costs	76.1	68.4	62.2	57.1	52.8

[1] Lumber sales price differential between green, dressed and rough, green mill-run lumber.

Even though lumber prices may drop to a level of marginal profit, the sawmill company can still market a higher product quality by selling dressed lumber. In a poor market, lumber buyers will prefer to purchase a planed lumber product, especially 1x3, 1x4 and 2x3 lumber at lower rough, green prices. As supply surpasses demand, lumber wholesalers become increasingly selective as to product quality including: lumber quality, lumber size, moisture content and lumber planing. Product quality is an important marketing tool that is overlooked by many sawmills.

4.4.2 Custom Planing

A sawmill has the opportunity to custom plane lumber with an existing planing mill. Dressing lumber for other sawmills or for the retail trade provides a company with manufacturing flexibility, as well as to guarantee a specific profit margin.

Manufacturing flexibility is important to a planing operation. No sawmill is able to control its customer's order demands or lumber markets. As a result, the sawmill company develops a problem in production scheduling. Any unnecessary downtime of lost production due to production scheduling problems is costly. Ideally, it is recommended that a planing mill pursue a small amount of custom planing to assist in meeting these production scheduling problems, especially during uncertain market conditions.

Custom planing can guarantee a specific profit margin. To ensure a planing mill is profitable while performing custom planing, management must know the actual production cost for its entire planing operation (including overhead and administration) for each product size and grade. Custom planing usually is costed at $30 to $40 per Mbf depending upon operating and marketing conditions. Knowing that an average planing mill has a production cost of approximately $22 per Mbf, it is not difficult to see the benefits of custom planing.

4.4.3 Secondary Manufacturing

The last and probably the most important value-added opportunity that a planing mill presents is one of an eye to the future. As previously mentioned, most N.B. sawmills have planing mills. Coupled with dry kilns, a planing mill enables a sawmill company to pursue a number of secondary manufacturing products. This subject will be investigated in greater detail in a later section.

A sawmill without dry kilns could employ any excess production capacity of its existing planing mill to produce the following products:

- softwood pallets;
- industrial blocking;
- snow fencing;
- crating;
- garden shed stock;
- short studs, etc.

Product prices and markets will be presented in the section "Short Lumber".

4.5 Short Lumber

4.5.1 Background

Everyone in the sawmilling industry knows the difficulty in marketing short lumber especially for smaller lumber dimensions. The following 1987 annual softwood lumber productions in billions of board feet are projected for each province:

. Quebec	4.5	61.7%
. Ontario	2.0	27.4%
. New Brunswick	0.6	8.2%
. Nova Scotia	0.2	2.7%
. Total	7.3 billion board feet	

Knowing that 5 percent of a mill's total lumber production is short lumber products and low-valued small dimension lumber, the eastern Canadian sawmilling industry will produce 365 million board feet annually.

The market for short lumber products and small dimension lumber is approximately 225 million board feet annually for eastern Canada and 1.95 billion board feet per year for eastern United States, respectively. Based on present consumption trends, there is a surplus of 140 million board feet annually in eastern Canada. Therefore, there exists a serious problem of market dumping for short and small dimension lumber throughout the sawmilling industry.

A common aspect of all successful sawmills has been their ability to maximize lumber value particularly this lower-valued, shorter length lumber despite poor market conditions. Their efforts have not come easy and only determination and aggressive marketing have generated higher dividends.

4.5.2 Marketing Impact on Profit

Until recently, most mills have overlooked the importance of better marketing as a value-added opportunity. In conducting many sawmill improvement studies and evaluating several capital investments, Forintek knows the impact of lumber value on mill profitability. Lumber value is the single most sensitive operating parameter influencing company profit. As a way of illustration, a 1 percent shift in lumber value will result in a 10.2 percent change in profit for an average sawmill operation throughout eastern Canada. The recommendation for an aggressive approach to marketing is not only for lower-valued and short length lumber but for a sawmill's entire product mix.

Lower-valued and short length lumber presents the greatest opportunity within the context of improving lumber value. Any improvement in lumber price for this material will have a larger percentage increase than for higher-valued lumber and therefore, a correspondingly larger change to mill profit. A $10 per Mbf increase to both 1 and 2 in. short lumber valued at $125 per Mbf versus 2x4 random length lumber valued at $300 per Mbf will yield percentage increases of 8.0 and 3.3 percent, respectively.

Therefore, a company is recommended to optimize its product value through increased marketing efforts, especially for short lumber products and small dimension lumber with lower product values.

The importance of short lumber is demonstrated by projecting this same $10 per Mbf increase in product value for all New Brunswick sawmills. There would be some extra material handling for sorting marketable products from short lumber; however, this material could potentially increase gross profit (before tax) by $100,000 for all New Brunswick sawmills with a total lumber production of 200 million board feet annually.

4.5.3 Short Lumber Products

The following identifies existing short lumber products and small dimension lumber uses by product size and lumber grade:

(i) short studs;
(ii) frame stock;
(iii) pallets;
(iv) prefabricated house components;
(v) fencing;
(vi) shed stock;
(vii) furring strips;
(viii) lath
(ix) boxes and crating, and
(x) short truss members.

(i) Short Studs

- 2x3, 2x4 and 2x6 in. for 6-foot length Standard and Better;
- short studs for below ground level basement walls;
- $130 and $240 per Mbf in Quebec and New Brunswick, respectively;
- market volume tied directly to larger metropolitan centers with high demand for residential house construction;
- market growth of 2 percent.

(ii) Frame Stock

- 1x2, 1x3, 1x4, 2x2, 2x3 and 2x4 in. for lengths of 30 to 96 in. Common to Utility;
- utilized as non-visual furniture components such as: bed frame;
- $200 and $230 per Mbf in Quebec and New Brunswick, respectively;
- market volume of 12 and 115 million board feet annually in eastern Canada and eastern United States, respectively;
- market growth of 3 percent.

(iii) Pallets

- 1x2, 1x3, 1x4, 2x3 and 2x4 in. for lengths of 26 to 60 in. Common to Economy;
- pallet lumber or pallet components; softwood pallets generally serves the throw-away pallet market;
- $170 per Mbf in Quebec and New Brunswick;

- market volume of 100 and 700 million board feet annually in eastern Canada and eastern United States, respectively;
- market growth of 5 percent.

(iv) Prefabricated House Components

- 1x3, 2x3 and 2x4 in. for lengths of 84, 88 3/4, 90 1/4 and 91 5/8 in. PET KD Standard and Better;
- MSR lumber potential;
- $225 per Mbf in Quebec and New Brunswick;
- market volume of 16 and 330 million board feet annually in eastern Canada and eastern United States, respectively;
- market growth of 3 percent.

(v) Fencing

- 1x2, 1x3, 1x4, 2x2, 2x3, 2x4 and 4x4 in. for lengths of 30 to 96 in. Common to Economy;
- residential and commercial fence material;
- $130 and $225 per Mbf in Quebec and New Brunswick, respectively;
- market volume of 13 and 120 million board feet annually in eastern Canada and eastern United States, respectively;
- market growth of 2 percent;
- retail building centers can expect better market growth for such products as: patio decking and picnic table kits.

(vi) Shed Stock

- 1x3, 1x4, 2x3 and 2x4 in. for lengths of 60 to 96 in. Common to Economy;
- garden sheds, baby barns and sauna kits sold by building centers;
- $130 and $240 per Mbf in Quebec and New Brunswick, respectively;
- market volume of 3 and 60 million board feet annually in eastern Canada and eastern United States, respectively;
- market growth of 2 percent.

(vii) Furring Strips

- 1x2, 1x3, 1x4, 2x2, 2x3 and 2x4 in. for lengths of 8 to 16 ft. Utility and Economy;
- backing for interior and exterior walls for easy installation of gypsum board or wall panelling and brick, respectively;
- $130 and 240 per Mbf in Quebec and New Brunswick, respectively;
- market volume of 40 and 385 million board feet annually in eastern Canada and eastern United States, respectively;
- market growth of 2 percent in United States only.

(viii) Lath

- 1 1/2 to 2 in. width x 3/8 in. thickness for lengths of 4 to 6 feet, no grade specifications required;
- snow fencing, lattice and stickers;
- $130 and $240 per Mbf in Quebec and New Brunswick, respectively;

- market volume of 16 and 20 million board feet annually in eastern Canada and eastern United States, respectively;
- little growth potential with the exception of lattice fencing.

(ix) Boxes and Crating

- 1x2, 1x3, 1x4, 2x2, 2x3 and 2x4 in. for lengths of 12 to 96 in. Common to Utility;
- product specifications are varied due to client needs;
- $130 and $240 per Mbf in Quebec and New Brunswick, respectively;
- market volume of 10 and 100 million board feet annually in eastern Canada and eastern United States;
- market growth will depend upon the outcome of export regulations concerning the utilization of wood to overseas markets;
- much of European products in transit requiring protective packaging is shipped in wooden boxes or crates.

(x) Short Truss Members

- 2x4 and 2x6 in. for lengths of 24 to 96 in. MSR lumber and Structural to Standard;
- inside web members of trusses (roof and floor) where strength and length requirements are less important than for random length MSR lumber;
- $300 per Mbf in Quebec and New Brunswick;
- market volume of 15 and 120 million board feet annually in eastern Canada and eastern United States;
- market growth of 4 percent for areas with close proximity to metropolitan centers of high residential demand.

4.5.4 Market Potential

All prices are for rough, green lumber FOB mill - CDN funds. Product prices are increased on average by approximately $25 per Mbf for kiln-dried condition. Prices for eastern United States are similar to New Brunswick prices, but do not present a value-added situation since they will not cover the high cost of transportation.

Therefore, there is little opportunity for marketing short lumber and small dimension products to the eastern United States or overseas as a result of generally low product prices and excessive transportation distances.

4.5.5 Product Alternatives

One alternative for short and low-valued lumber is to chip this lumber volume; or is it? The value of chips would be approximately $60 per Mbf based on a chip price of $70 per O.D. tonne - net FOB mill and a chip factor of 0.78 O.D. tonnes per Mfb. Chipping lumber already manufactured is not a viable alternative.

If local markets can not be identified nor higher prices secured to meet high transportation costs, the only other alternative is to manufacture a higher-valued product. New Brunswick sawmills must consider producing a finished product and not a commodity product to obtain higher product values. The first phase to this manufacturing strategy is to install dry kilns to either sell or produce dry lumber.

4.6 Installation of Dry Kilns

4.6.1 Importance of Lumber Drying

The installation of dry kilns is not only important for its added value to a sawmill's total product value but, also, as a forerunner to grater value-added opportunities. Once a mill is producing dry lumber, other secondary manufacturing products such as: window and door moldings and furniture components, etc., enable a sawmill to diversify in the future. Producing dry lumber will provide a mill much more manufacturing flexibility in pursuing a feasible opportunity of forward integration. It is for these reasons that this section was emphased.

A sawmill must give this value-added opportunity a great deal of thought with respect to company direction for its long-term future. Since the installation of dry kilns will open the door to many secondary manufacturing options, it is important for a sawmill to consider realistic investment strategy at this stage. Mill management should know what products they want to market so that the dry kiln facilities will be adequate to support these long-term operations.

4.6.2 Kiln Drying Facilities

An investment analysis was performed to determine the economic feasibility of installing kiln drying facilities. Two scenarios were considered with the only difference being the mixture of material that was to be dried:

Scenario A	Scenario B
. 5 MMbf SPF studs	. 5 MMbf SPF studs
. 4 MMbf SPF shorts	. 2 MMbf WP lumber
. 2 MMbf WP lumber	
11 MMbf total lumber	7 MMbf total lumber

Short lumber is considered as material less than 8 feet in length. Scenario B did not include this material since the added value was limited to only an inventory saving of only $2.60 per Mbf.

White pine lumber was considered for the dry kiln investment analyzes for two reasons. First, most softwood mills saw whatever white pine raw material supply they can secure for its higher lumber value and, therefore, higher profit margin. Secondly, drying white pine lumber increases the value-added differential between green and dry lumber prices which will result in a higher internal rate of return and lower payback period.

The calculated price differentials between green and dry lumber for SPF studs, SPF shorts and WP No. 3 Common and Better lumber are shown in Appendix V. The net weighted average added value for this dry kiln investment analyses was $30.94 and $49.20 per Mbf considering Scenarios A and B, respectively. A 2 percent lumber degrade factor was employed to all lumber to realistically simulate a sawmill's actual value-added dry lumber price differential.

The investment opportunities for the addition of kiln drying facilities assumes an established market for dry lumber. The analyses will develop an internal rate of return and payback period for the investment. In addition, the sensitivity of rate of return to sales volume, selling price, variable costs, fixed costs and facilities cost will be determined. Two types of dry kiln systems were considered:

a) Conventional steam heated kiln with a residue-fired (sawdust and planer shavings) boiler

b) Dehumidification kilns operating at up to 160°F (71°C)

Both drying systems were selected for Scenario A. However, the results were not favorable for a dehumidification kiln and, therefore, only a conventional steam-heated kiln was considered for Scenario B. The total dry kiln analysis is first presented for Scenario A then again for Scenario B.

4.6.3 Dry Kiln Capacity

In order to determine the required kiln capacity for Scenario A, the following assumptions were employed:

- the current mixture of lumber sizes, grades and species will not change considerably;
- the current volume of material falling within the above criteria is approximately 11.0 MMbf/year, and
- any excess kiln capacity will be used to dry other grades for which there may be an occasional demand.

Table 8 shows the calculated kiln capacity required to dry the desired volume of material. Allowances have been made for loading and unloading time as well as 2 percent downtime for repairs and maintenance.

The recommended kiln layout was selected as follows:

- Conventional-residue system: three-sided loading kiln of 40, 40 and 45 Mbf, respectively;
- Dehumidification system: four-sided loading kiln with three bays which will be 40 Mbf and the fourth being 45 Mbf

While larger dehumidification units are available, it is believed that because of the variety of products to be dried and varying drying times, four medium-sized dehumidifier kilns are more suitable than three larger units. This will provide added flexibility to the kiln drying operation by simplifying kiln scheduling especially for white pine lumber.

Table 8

Dry Kiln Capacity

Species	Lumber Thickness (in.)	Annual Volume (Mbf)	Drying Time[1] Conv. (days)	Drying Time[1] Dehumid. (days)	Kiln Capacity Conv. (Mbf)	Kiln Capacity Dehumid. (Mbf)
SPF Studs	2	5,000	2.5	3.3	36.5	48.6
SPF Shorts	1	720	1.5	2.0	3.2	4.2
	2	3,280	2.5	3.3	24.0	31.9
White Pine	1	1,000	7.0	11.0	20.4	32.3
	1 1/2	400	11.0	14.0	12.9	16.0
	2	600	15.0	18.0	26.1	31.6
Total		11,000	3.8[2]	5.1[2]	123.1	164.6

[1] Average time including loading and unloading

[2] Average time per kiln charge

4.6.4 Equipment Capital Costs

The capital costs for equipment are listed in detail in Appendix VI. The total capital costs for the two systems are:

a) Conventional kiln with a residue-fired boiler.....$925,000
b) Dehumidification kiln capable of reaching 160°F...$835,000

4.6.5 Operating Costs

Operating costs include expenses for energy, labour, overhead and inventory carrying cost. Estimates for all of these have been made and are listed in detail in Appendix .

Total annual operating costs for each system are:

a) Conventional kiln with residue-fired boiler.....$165,392/year
b) Dehumidification kiln capable of reaching 160°F..$265,337/year

4.6.6 Revenues from Kiln Drying Operations

The revenue component in the analysis is the average price differential between green and kiln dried lumber. After weighing all the price differentials for the various products, we have arrived at a composite price differential of $37.05 per Mbf. A degrade allowance of 2 percent of the green lumber value of $305.63 per Mbf (once again this is a weighted price) gives a net value added of $30.94/Mbf and an incremental revenue of $340,340 in the first year. This analysis will be valid only if the above price differential can be obtained.

4.6.7 Investment Analysis

Table 9 lists the input data used in the computerized cash flow analysis. Table 10 shows the results of the analysis at the price differential identified earlier. The analysis indicates that at the present time, given the present input parameters, neither system is economically viable. However, the Conventional Residue system is marginal with an internal rate of return of 13.9 percent and a payback period of 5.5 years.

As in the global mill analysis, the sensitivity of the investment is most sensitive to unit sales and unit price. If for example, the unit price could be increased by 10 percent, the internal rate of return for the Conventional-Residue system would rise to approximately 17.8 percent. The breakeven price differential required to yield a 14 percent after tax return on the initial investment is $31.06.

4.6.8 Dry Kiln Capacity

The following dry kiln analysis is presented for Scenario B which considered drying only SPF stud lumber and WP grade lumber. Drying SPF short lumber was excluded from this section as it only served to significantly reduce the value-added lumber price differential. The

Table 9

Summary of Kiln Drying Investment Analysis Input Data

Working Capital	6%
Combined Federal & Provincial Tax Rate	20%
Lower Limit for Return on Investment	14%
Time Period for the Investment Analysis	10 years
Price Differential	$30.94/Mbf
Unit Sales	11.0 MMbf/year
Depreciation Schedule	10 years
Operating Costs:	
a) Conventional-Residue	
- Variable (energy, labour, inventory)	$110,942
- Overhead	$ 54,450
b) Dehumidification	
- Variable (energy, labour, inventory)	$215,727
- Overhead	$ 49,610
Investment Costs:	
a) Conventional-Residue	
- Facilities	$925,000
- Replacement or Overhaul in 5th year	$ 63,000
b) Dehumidification	
- Facilities	$835,000
- Replacement or Overhaul in 5th year	$ 56,700
Salvage Value:	
a) Conventional-Residue	$ 92,500
b) Dehumidification	$ 83,500
Investment Tax Credit of the Installed Facilities Cost:	
a) Conventional-Residue	$ 64,750
b) Dehumidification	$ 58 450

Table 10

Return on Investment and Payback Period

Input Parameters	Conventional Residue					Dehumidification				
	reduced by 20%	reduced by 10%	as used	increased by 10%	increased by 20%	reduced by 20%	reduced by 10%	as used	increased by 10%	increased by 20%
Sales Volume	4.8	9.6	13.9	17.8	21.6	-16.4	-7.0	0.0	5.8	10.8
Price Differential	4.8	9.6	13.9	17.8	21.6	-16.4	-7.0	0.0	5.8	10.8
Variable Costs	17.0	15.4	13.9	12.2	10.5	8.1	4.2	0.0	-4.9	-10.6
Fixed Costs	15.2	14.5	13.9	13.2	12.5	1.8	0.9	0.0	-1.0	-2.0
Facilities Cost	20.1	16.6	13.9	11.5	9.5	4.4	1.9	0.0	-1.6	-2.9
Payback Period on Facilities	5.5 years					greater than 10 years				
Present Value of Investment (i=14%)	-$6,000					-$433,000				

previous section showed that lumber value (price differential) had the largest sensitivity on the dry kilns internal rate of return.

As a result of the poor showing of the dehumidification type kiln in Scenario A, it was decided to concentrate strictly on the Conventional-Residue type kiln for Scenario B. The same assumptions have been made in Scenario B as in Scenario A with the exception that the current amount of material falling within the criteria will be approximately 7.0 MMbf annually. Table 11 shows the calculated kiln capacity for Scenario B. The recommended kiln layout will be 3-sided loading kilns of 40, 40 and 20 Mbf, respectively.

4.6.9 Operating Cost

Operating costs include expenses for energy, labour, overhead and inventory carrying cost. Estimates for all these have been made and are listed in detail in Appendix VII. Total annual operating costs for the Conventional residue-fired kilns are $133,245.

4.6.10 Revenues from Kiln Drying

As in Scenario A, the revenue component in this analysis is the average price differential between green and kiln-dried lumber. Again, the price differentials were weighted for the products to be dried in Scenario B and an average gross price differential of $56.75 per Mbf was calculated. After subtracting degrade allowance of 2 percent of the composite green lumber value of $377.47 per Mbf, the net value-added from kiln drying becomes $49.20 per Mbf. This results in an incremental revenue of $344,400 in the first year. This analysis will be valid only if the above price differential can be obtained.

4.6.11 Investment Analysis

Table 12 lists the input data used in the computerized cash flow analysis. Table 13 shows the results of the analysis at the price differential identified earlier. The analysis indicates that the conventional residue system is economically viable with an internal rate of return of 22.8 percent and a payback period of 4.1 years. The kiln investment analysis is most sensitive to unit sales and unit price. If for example the price differential drops by 10 percent, internal rate of return will be reduced to 18.2 percent and similarly a 20 percent drop in the price differential will result in an internal rate of return of only 13.4 percent making the investment uneconomical.

The breakeven price differential required to yield a 14 percent after tax return on the initial investment is $39.99 per Mbf leaving a buffer of $9.21 per Mbf.

Table 11

Dry Kiln Capacity

Species	Lumber Thickness (in.)	Annual Volume (Mbf)	Drying Time[1] Conventional	Drying Time[1] Residue (days)	Kiln Capacity Conventional	Kiln Capacity Residue (Mbf)
SPF Studs	2	5,000	2.5		36.5	
White Pine	1	1,000	7.0		20.4	
	1 1/2	400	11.0		12.9	
	2	600	15.0		26.1	
Total		7,000	4.7[2]		95.9	

[1] Average time including loading and unloading

[2] Average time per kiln charge

Table 12

Summary of Kiln Drying Investment Analysis Input Data

Working Capital	6%
Combined Federal & Provincial Tax Rate	20%
Lower Limit for Return on Investment	14%
Time Period for the Investment Analysis	10 years
Price Differential	$49.20/Mbf
Unit Sales	7 MMbf/year
Depreciation Schedule	10 years
Operating Costs	
- Variable (energy, labour, inventory)	$ 88,025
- Overhead	$ 45,220
Investment Costs	
- Facilities	$772,000
- Replacement or Overhaul in 5th year	$ 52,850
Salvage Value	$ 77,200
Investment Tax Credit of the Installed Facilities Cost	$ 54,850

Table 13

Return on Investment and Payback Period

Input Parameters	Conventional Residue reduced by 20%	reduced by 10%	as used	increased by 10%	increased by 20%
Sales Volume	13.4	18.2	22.8	27.1	31.3
Price Differential	13.4	18.2	22.8	27.1	31.3
Variable Costs	25.6	24.2	22.8	21.3	19.8
Fixed Costs	24.0	23.4	22.8	22.1	21.5
Facilities Cost	30.4	26.2	22.8	19.9	17.4
Payback Period on Facilities	4.1 years				
Present Value of Investment (i=14%)	$305,000				

4.6.12 Summary

A feasibility analysis was carried out to determine whether or not it would be economically attractive to install drying facilities. Two different scenarios were considered. Scenario A outlined an internal rate of return of 13.9 and 0.0 percent for Conventional Residue and Dehumidification type kiln investments, respectively, making Dehumidification less viable than Conventional Residue. The high volume of SPF short lumber limited the economic feasibility for both kiln analyses.

It is evident that a kiln drying operation is warranted for Scenario B providing there is a market for the dry lumber. The Conventional Residue system of Scenario B produced an internal rate of return of 22.8 percent with a payback period of 4.1 years. Scenario B was much more financially attractive as a result of excluding SPF short lumber. At this time, it is recommended that this option be further investigated to eliminate the assumptions regarding market volume, market price and capital equipment costs.

4.7 Remanufacturing Plant

4.7.1 Background

Remanufacturing must not be confused with secondary manufacturing or millwork. It is characterized on the basis of products produced and defined as a sector between sawmilling/planing and secondary wood product manufacturing.

Lumber remanufacturers are differentiated from sawmills/planing mills since their raw material input is lumber, flitches or cants rather than tree-lengths or sawlogs. Lumber remanufacturers are separated from secondary manufacturing since they produce lumber, components and semi-finished parts requiring additional manufacturing or assembly by secondary industries into a furniture product. Lumber remanufacturers are distinguished from millwork plants on the basis that millwork is a product machined at a planing mill such as: mouldings, door frames, sash and window stock and stair work. The exception to this definition is specialty products such as: panelling and siding for which are specified by provisions outlined in the NLGA Standard Grading Rules for Canadian Lumber.

4.7.2 Introduction

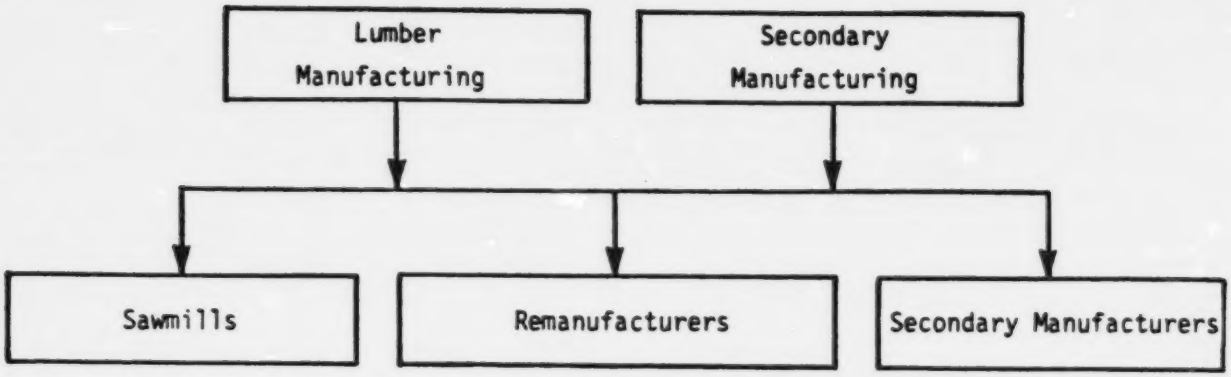
Remanufacturing has gained in popularity recently as a value-added opportunity; especially in the softwood industry. Declining sawlog quality and low profit margins from shifting market demand and increasing international competition, have generated a new solid wood products sector within the softwood industry. Obtaining a higher product value from the available timber resource allows diversification from the traditional marketplace of commodity lumber.

In the context of this section, remanufacturing will consider lumber remanufacturing and specialty remanufacturing. Lumber remanufacturing is the process of ripping lumber, flitches or cants into smaller sizes. It also includes the operation of upgrading low grade or mismanufactured lumber. Specialty remanufacturing is the process of profiling lumber into panelling, siding and other patterns. This category is oriented towards the do-it-yourself market. Remanufacturing of wood components will be addressed in a later section of this report. The definition of remanufacturing by products is more clearly illustrated in Figure 1.

4.7.3 Marketing Strategy

Common throughout the remanufacturing sector is its market orientation or customized products. Companies within this sector are constantly on the look for new product lines. The market potential is greatly determined by this competitive nature to identify specialty markets.

Many remanufacturers consider product flexibility as an important marketing tool. These plants are in a better position to satisfy a potential client by producing a variety of products of short production runs. However, others are of the opinion that it is best to specialize in order to optimize production efficiency. Market volume will, for the most part, determine a company's marketing strategy.



- lumber
- chips
- shavings
- bark

1. Lumber Remanufacturing
   - standard dimension
   - clears
   - bedstock
2. Specialty Remanufacturing
   - panelling
   - siding
   - mouldings
3. Wood Components
   - glued-up panels
   - cut stock
   - squares

- furniture
- millwork
- wood turning
- pallets

Figure 1. Defining the Remanufacturing Industry

If a region's market volume for a specific remanufacturing product is small but offers a profitable investment, then the remanufacturing plant must be designed for maximum flexibility. On the other hand, if a company is able to secure larger contracts without sacrificing potential product diversification, then the remanufacturing plant should become more specialized.

In the case of establishing a remanufacturing plant in New Brunswick, there is no one product able to satisfy the production capabilities of a minimum economic plant size. This N.B. remanufacturing plant would have the advantage of producing several value-added products with close proximity to local or domestic markets for much of the plant's production capacity. Therefore, it is recommended that such a plant be based on the economy of flexibility.

4.7.4 Market Potential

Marketing information for the remanufacturing industry is not readily available. The term remanufacturing is relatively new and coupled with the fact this industry has a diverse infrastructure, market information has been difficult to obtain.

However, an attempt to identity the remanufacturing industry as to market volume and market potential. The following wood-using sectors outlined in Statistics Canada were employed to reflect this industry:

- sawmills and planing mills;
- sash, door and other millwork;
- other millwork industries;
- kitchen cabinet and vanity;
- wooden door and window;
- wooden box and pallet;
- coffin and casket;
- prefabricated wood building, and
- other wood industries.

The above primary and secondary wood-using industries defines the clientele of the remanufacturing industry. By quantifying and analyzing the value of materials utilized by these wood-using sectors, some indication of market volume and market potential can be determined for the remanufacturing industry.

Table 14 outlines the value of materials utilized by each wood-using sector of the remanufacturing industry for New Brunswick, Atlantic provinces and eastern Canada. Excluding sawmills and planing mills since this sector implies more primary than secondary manufacturing, the remanufacturing industry is $75, $130 and $1,684 million in size, respectively.

Table 15 shows the value of materials by wood-using industry in Canada. The remanufacturing industry has steadily grown each year by increasing its market share of the total wood-using industry from 88.3 percent in 1980 to 90.7 percent in 1984. Eventhough sawmills and planing mills sector has remained essentially unchanged at approximately 64 percent, the secondary wood-using industries have increased from 24.1 percent in 1980 to 26.3 percent in 1984. Although the percentage increase is only 2.2 percent over 5 years, the monetary growth of the remanufacturing industry is $10.5 million dollars annually. Furthermore, the available market growth has been satisfied by approximately the same number of

Table 14

Value of Materials for Remanufacturing Industries

Wood Industry	New Brunswick	Atlantic Provinces	Eastern Canada
	..... millions of dollars		
Sawmills and Planing Mills	119	152	1,290
Sash, Door and Other Millwork	22	36	622
Other Millwork Industries	2	10	132
Wooden Door and Window	16	30	285
Kitchen Cabinet and Vanity	4	5	147
Other Miscellaneous Wood Industries[1]	31	49	498
Remanufacturing Industries	75	130	1,684

[1] Includes wooden box and pallet, coffin and casket, prefabricated wood building and other wood industries.

Source: Statistic Canada Cat. No. 25-202, 35-204, 35-205, 35-206, 35-208, 35-209 and 35-210 (1984 current edition).

sawmills and planing mills over this period; thereby, providing an expanding market for an existing sawmill and/or planing mill.

The remanufacturing industry in eastern Canada and particularly for the province of New Brunswick offers an excellent value-added opportunity. The existing market size and steady market growth speaks well for an established sawmill or lumber wholesaler especially with the number of sawmills and planing mills likely to remain constant. The province of New Brunswick has good remanufacturing markets based on its diverse array of secondary manufacturers at the domestic level and close proximity to the highly established furniture markets in Quebec and northeastern United States. There appears little need to pursue the available but extremely competitive overseas markets.

The largest percentage increase in growth shown by the remanufacturing industry was in the other wood industries. This sector includes: prefabricated wood building, kitchen cabinet and vanity, wooden door and window and coffin and casket industries. Previous research literature has indicated that both the wooden door and window and coffin and casket industries are actually declining. Therefore, the real growth within the remanufacturing industry is the prefabricated wood building and kitchen cabinet and vanity industries. Both these two industries will be addressed in the following report sections: "Machine Stress-Rated Lumber" and "Dimension Stock Components", respectively. In addition, these two industries are also closely integrated with the residential housing industry.

The market potential for the remanufacturing industry can also be derived from investigating the status of the residential housing industry and its growth trends. Wood products is still the preferred building material for housing since more than 90 percent of new single-family houses are wood frame construction.

Building systems employing non-wood materials have generally not been successful. However, plastic and aluminum windows and insulated steel doors have captured an increasing market share from these traditional wooden products. Lower prices for wood products relative to non-wood substitutes have, for the most part, been enough of a deterrent to maintain the high level of wood products used in residential housing.

Wood products used per housing unit is expected to increase. As a result of recent trends to larger, higher quality houses employing a greater proportion of wood, the remanufacturing industry will supply much of this demand. Although house framing accounts for 70 percent of the lumber in a single-family dwelling, the remaining 30 percent is comprised of the following products:

- kitchen cabinets and vanities;
- sheating;
- siding;
- mouldings;
- sash and door stock;
- millwork;
- garage doors, and
- patio decks.

Table 15

Value of Materials by Wood-Using Industry[1]

Wood Industry	Year 1980	1981	1982	1983	1984
	..... millions of dollars				
Sawmills and Planing Mills	3,122 64.2%	2,929 61.0%	2,608 63.7%	3,443 65.0%	3,641 64.4%
Sash, Door and Other Millwork	790 16.2%	905 18.8%	685 16.7%	872 16.5%	904 16.0%
Wooden Box and Pallet	102 2.1%	110 2.3%	97 2.4%	85 1.6%	105 1.9%
Other Wood Industries	284 5.8%	322 6.7%	299 7.3%	378 7.1%	473 8.4%
Remanufacturing Industry	4,298 88.3%	4,266 88.8%	3,689 90.1%	4,778 90.2%	5,123 90.7%

1 Veneer and plywood and shingle and shake industries not considered as remanufacturing industries.

Source: Statistics Canada Cat. No. 25-202, 35-204, 35-205, 35-206 and 35-208 (1984 current edition).

Economists expect the real GNP to continue to grow 3 percent annually into the year 2000. Housing demand is at its peak now and will marginally decline through to the turn of century; however, housing is anticipated to rise slightly in the early part of the new century. In addition, the proportion of single-family housing is projected to maintain its high level of importance within the residential housing industry.

In summary, the position of wood products is likely to continue as the dominant house building material in the short and long term future. This situtation is the result of lower costs, traditional end-uses, flexibility as a building product and increased quality control practices for wooden products. The only real competition to wood as the best building material is itself. As a result of poor quality control in the past, architects and building engineers has specified engineered products such as: machine stress-rated lumber, designed floor and roof trusses and composite wood products over commodity dimension lumber and plywood.

The remanufacturing industry not only emphasizes the value-added concept of traditional wood products but, also, is expected to supply and an increasing demand for wood products with the steady growth trends predicted for the residential housing industry in the future.

4.7.5 Plant Description and Capacity

The proposed remanufacturing plant will consider a diverse product mix and practice the concept of economy of flexibility rather than economy of scale. The equipment selection must reflect the plant's wide range of manufactured products servicing several markets.

The capacity of the lumber remanufacturing plant is based on the following operating parameters:

- moulder feed speed of 200 lft. per min.;
- 74% uptime (26% downtime and delays);
- average lumber input of 1x5 in. lumber;
- 45 operating hours per week;
- 48 operating weeks per year, and
- a waste factor of 5 percent.

Therefore, the lumber manufacturing plant is able to process a lumber volume input of 8 MMbf per year. Furthermore, the volume recovery of finished products considering a waste factor of 5 percent is 7.6 MMbf annually.

4.7.6 Raw Material

Assuming that a 20 million board foot sawmill has a species mix of 85 percent SPF and 15 percent white pine, this plant will process the following lumber mix:

- 2.4 MMbf of SPF shorts;
- 0.6 MMbf of SPF dimension;
- 2.0 MMbf of sawmill white pine;
- 2.0 MMbf of purchased white pine; and
- 1.0 MMbf of purchased hardwoods.

---

8 MMbf of total lumber input

To supplement an integrated sawmill's raw material lumber input of 2.0 MMbf of white pine, 2.4 MMbf of SPF shorts and 0.6 MMbf of SPF dimension, additional lumber must be purchased from local sawmills to satisfy the remanufacturing plant's capacity. The supplemental lumber distribution of an additional 2.0 MMbf of white pine and 1.0 MMbf of hardwood (80 percent oak and 20 percent yellow birch and hard maple) was assumed for maximum product flexibility.

The resulting weighted raw material lumber cost is as follows:

. sawmill SPF dimension	7.5%	x	$360 per Mbf
. sawmill SPF shorts	30.0%	x	$227 per Mbf
. sawmill white pine	25.0%	x	$530 per Mbf
. purchased white pine	25.0%	x	$550 per Mbf
. purchased hardwoods	12.5%	x	$800 per Mbf
. raw material cost			$465 per Mbf

All prices are for kiln-dried lumber FOB remanufacturing plant CND funds. The white pine and SPF shorts supplied by the integrated sawmill include a $20 material handling cost instead of a transportation cost for lumber delivery. The purchased white pine and hardwood lumber prices include a $40 transportation cost for purchasing delivered lumber on the open market. Appendix X represents the detailed costing calculations for the average prices used for each species in determining the weighted raw material cost.

The average weighted raw material cost for a remanufacturing plant processing the above product mix of white, SPF dimension and shorts and hardwoods is $465 per Mbf FOB remanufacturing plant CDN funds.

4.7.7 Remanufacturing Products

Solid wood lumber products produced by the remanufacturing industry are specific to the three (3) remanufacturing sectors: (i) lumber remanufacturing; (ii) specialty remanufacturing, and (iii) wood components.

(i) Lumber Remanufacturing
- standard dimension lumber
- shop and clear grades
- sash and door stock
- bedstock

(ii) Specialty Remanufacturing
- wall panelling or wainscotting
- bevel or shiplap siding
- flooring
- mouldings or other profiling mill work

(iii) Wood Components
- glued-up panels
- cut door stock
- squares

4.7.8 Product Prices

Although the emphasis is to utilize softwoods in a value-added product, the proposed remanufacturing plant must also use white pine and hardwoods to satisfy production capacity and improved manufacturing flexibility and product value. Product prices must therefore consider species.

This section will not emphasize the manufacturing of wood components as part of this investment for two important reasons. The cost of specialized equipment required to produce wood components is too great to be included in the same plant. Secondly, the equipment layout for dimension stock components would increase the plant size to an efficient scale. However, such products as: rough solid cut stock and squares requires little equipment specialization so as not to exclude these hardwood products.

Important to the investment analysis of a remanufacturing plant is the distribution of lumber remanufacturing and specialty products. In order to take a conservative approach in determining a weighted average product value, the following product distribution was assumed in determining a weighted average product value, the following product distribution was assumed in determining the average weighed product value:

. SPF dimension and clears	7.5% x $ 390 per Mbf
. SPF bedstock	30.0% x $ 300 per Mbf
. white pine panelling	25.0% x $ 600 per Mbf
. white pine siding	25.0% x $ 750 per Mbf
. oak door stock and flooring	10.0% x $2,500 per Mbf
. birch and maple squares	2.5% x $3,750 per Mbf
. average product price	$ 800 per Mbf

The product price for producing higher quality SPF dimension and sorting for SPF clears is based on adding value through customized remanufacturing as descried in the following:

- process product sizes and/or product grades that cannot be economically processed by sawmills;
- remanufacture edging, trimming and grading mistakes into high-valued products, and
- custom remanufacturing facilities to service building contractors and other lumber wholesalers at a one-stop building materials center.

The product price for SPF bedstock sells for approximately $230 per Mbf air-dried. However, it can also be marketed as cut-to-length, kiln-dried bedstock components valued $300 per Mbf FOB mill CDN funds.

The white pine panelling price is based on utilizing 4/4 1x8 in. No. 3 Common lumber and the white pine siding price is based on using 5/4 1x8 in. No. 3 Common lumber. Both these white pine products are produced form random length lumber and are not a specific cut-to-length product. Product values would be significantly higher if panelling and siding products and not lumber were sold to lumber retail outlets.

4.7.9 Processing Equipment and Production Costs

The processing equipment for a lumber remanufacturing plant is similar to that found in a planing mill using band resaws and planers (matchers), but also circular ripsaws, cross-cut saws and multi-saw trimsaws are used throughout the sector of remanufacturing. Other wood machining equipment such as: profiling, routing, turning, etc. required by the specialty remanufacturers employ similar processing equipment found in the millwork industry. Remanufacturing facilities for the production of wood components requires woodworking equipment similar to that of the roughmill department of a furniture plant. This equipment will include: cross-cut saws, ripsaws, edge-gluing clamps, radio-frequency dryers, abrasive planers, etc. Additional equipment such as: belt sanders, double-end tennoners, boring machines, etc. will be required depending on custom orders.

One of the most overlooked aspects of lumber remanufacturing, like secondary manufacturing, is the need for material handling equipment. This includes equipment such as: tilt hoists, transfer conveyors, automated infeed and outfeed tables, etc. Material handling is necessary for the efficient movement of smaller lumber pieces or wood components through the grading, sorting, stacking, packaging and shipping operations. Automating the manual process of lumber handling should be viewed as a labour-saving technology.

Table 16 outlines the processing equipment suggested for a remanufacturing operation specifically designed to service a variety of value-added products. The processing equipment selected for this remanufacturing plant investment is based on the operating parameters presented in the previous section "Plant Description and Capacity".

Table 16

Remanufacturing Plant Production Costs

Land Costs:	
. 1 acre at $5,000 per acre	$ 5,000
. depreciation at 10 percent	$ 500
Building Costs:	
. dry storage building of 75' x 250' at $15 per ft² for kiln dried lumber	$ 281,250
. dry storage building of 75' x 150' at $15 per ft² for finished products	$ 168,750
. remanufacturing plant of 75' x 150' at $70 per ft² complete with offices, heating, plumbing, electrical, humidification, dust collection, compressed air and sprinkler systems	$ 787,500
. depreciation at 10 percent	$ 123,750
Equipment Costs:	
. infeed unscrambler at resaw	$ 10,000
. rebuilt resaw	$ 50,000
. outfeed table from resaw	$ 5,000
. moulder inclosed in a sub-room	$ 100,000
. infeed unscrambler to multi-saw trimmer	$ 5,000
. multi-saw trimmer	$ 25,000
. sorting and grading table	$ 10,000
. stacker	$ 30,000
. hogger and shavings shed	$ 35,000
. cross-cut saw	$ 20,000
. ripsaw	$ 20,000
. profile tooling	$ 10,000
. residue systems	$ 75,000
. wrapping machine	$ 20,000
. front-end loader	$ 125,000
. depreciation at 20 percent	$ 108,000
. installation of equipment	$ 100,000
Variable Costs:	
. 15 employees at $8.00 per hour	$ 259,200
. 1 foreman at $10.00 per hour	$ 21,600
. 1 supervisor at $17.00 per hour	$ 39,800
. indirect benefits at 20 percent	$ 71,000
. utilities and fuel	$ 80,000
. selling expense at 6 percent of sales	
Fixed Manufacturing Costs:	
. maintenance and supplies	$ 75,000
. packaging and shipping materials	$ 25,000
. shop sundary	$ 25,000
Overhead Costs:	
. general manager	$ 75,000
. administration and insurance, etc.	$ 225,000
. contingency	$ 100,000

The total capital investment on facilities cost for a remanufacturing plant is calculated at $1,882,500 including land, buildings, processing equipment, rolling stock, machinery installation and working capital.

The total operating cost for this investment is $1,228,800 including variable labour and indirect benefits, utilities and fuel, fixed manufacturing costs, depreciation and overhead costs.

4.7.10 Investment Analysis

An investment analysis for a remanufacturing plant was conducted for the operating parameters of product volumes and prices and production costs calculated in previous sections. The internal rate of return (IRR) for this capital investment is 32.5 percent with a payback period of approximately 3.0 years.

Table 17 outlines the sensitivity of this analysis for the major operating parameters. The proposed remanufacturing plant investment is able to withstand a 20 percent decrease in sales volume while still yielding a 19.4 percent IRR. However, this investment is very sensitivity to product price and is able to absorb only a 10 percent decrease in unit price while substaining a marginal 11.8 percent IRR. The other operating parameters have much less affect upon investment profitability.

The resulting breakeven operating levels for this remanufacturing plant investment were determined as follows:

- product price - $721 per Mbf-product tally;
- sales volume - 6.849 MMbf- product tally;
- facilities cost - $3,336,900

The breakeven levels were based on an IRR of 12 percent and an effective tax rate of 40 percent for both federal and provincial taxes.

4.7.11 Summary

A remanufacturing plant investment proves to be a feasible value-added opportunity supported by a good internal rate of return and a moderate payback period. The sensitivity analysis of the investment (Table 17) shows that the proposed remanufacturing plant is economically viable despite a 20 percent drop in product sales. However, this capital investment is quite sensitive to product price and is only able to endure a 10 percent decrease before becoming an unprofitable investment.

Therefore, it is recommended that interested sawmill companies investigate the following important operating variables with respect to their own situation:

- product mix;
- product prices;
- sales volume, and
- lumber grade mix.

Table 17

Sensitivity Analysis for a Remanufacturing Plant Investment

Operating Parameter	Percent Change of Operating Parameter				
	80	90	100	110	120
	..... internal rates of return				
Sales	19.4	26.2	32.5	38.3	43.8
Price	-26.0	11.8	32.5	50.3	67.1
Variable Cost	62.8	47.8	32.5	15.6	-6.6
Fixed Manufacturing Cost	36.0	34.3	32.5	30.7	28.8
Facilities Cost	38.6	35.3	32.5	30.1	28.0

Successful remanufacturers will be those companies able to best purchase lumber from primary producers as well as improve their own lumber grade mix for maximum profitability. Expert knowledge with respect to lumber grading rules and product specifications is essential for remanufacturing operations to secure the optimum raw material supply for the production of high quality, value-added products. Furthermore, successful remanufacturers will be those companies able to best develop specialty wood products within a dynamic marketplace. Remanufacturing is market-oriented and, therefore extremely volatile to market changes and trends.

4.8 Machine Stress-Rated Lumber

4.8.1 Introduction

Machine stress-rated (MSR) lumber is not a new product with some mills manufacturing it for more than 20 years. MSR lumber has recently gained significant recognition for two main reasons.

Commercial application has shown that machine stress-rating is able to outperform visual grading. MSR lumber is able to employ a greater percentage of a mill's lumber volume in higher grades than with visual graded lumber. In addition, MSR lumber grades provide the building industry with a more reliable lumber product by reducing traditional variability in strength and stiffness characteristics. The result has been that in Canada and in the United States, as well as in other international parts of the world, MSR lumber has been adopted as an engineered lumber product accepted for its better product quality and higher reliability.

MSR lumber competes against visual stress-graded (VSR) lumber from structural grades of No. 1 and No. 2 lumber to lumber graded by appearance. With VSR lumber, there are problems with strength reliability for building architects and design engineers. This situation has resulted in severe lumber grading by the sawmilling industry and over designing by the building industry. MSR lumber enables fabrication of our wood structures at a lower manufacturing cost by using less material for the same strength properties with greater product reliability.

All this translates into a bright and expanding future for MSR lumber. A product such as MSR lumber has surfaced at a good time when sawmills are in search of new products that will add value to their company operations.

4.8.2 Market Potential

The market potential for MSR lumber is enormous! In North America, MSR lumber consumption is projected at 4 billion board feet annually with British Columbia lumber producers currently only satisfying 1 billion board feet per year and U.S. producers supplying another 1.5 billion board feet. The rest of the market, or approximately 1.5 billion board feet, presently goes to visual stress-rated lumber and structural grade lumber.

There are four (4) major market areas that present an opportunity for MSR lumber:

- roof and floor truss industry;
- joist industry;
- laminating industry, and
- mobile home industry.

Table 18 shows the maximum market potential for MSR lumber considering the truss and joist industries only. Although there is no potential growth in the roof truss industry, there is 390 and 60 million board feet of available market in U.S. and Canada's floor truss industry, respectively. In addition, there is 450 and 50 million board feet of non-residential MSR lumber potential in the U.S. and Canada's truss and joist fabrication industry, respectively.

Table 18

Maximum Potential Market for MSR Lumber[1]
(Truss and Joist Fabricating Industry Only)

MSR Lumber Market	United States		Canada	
	Current Level Penetration	Maximum Penetration	Current Level Penetration	Maximum Penetration
	.....millions of board feet.....			
Residential				
Roof	630	630	50	50
Floor	130	520	10	70
Non-Residential	630	1080	35	85
Total	1390	2230	95	205

[1] Based on 1.6 million U.S. and 200,000 Canada housing starts

Source: Woodbridge and Reed Assoc. (1982) report conducted for Forintek Canada Corp.

The greatest market potential of MSR lumber includes the truss and joist industries for residential and non-residential construction. Although there is MSR potential in the laminating and mobile home industries, these market areas were not included in this total lumber consumption. It is thought that a MSR producer would need to develop these market areas since size and grade requirements are different from the standard truss and joist industries.

MSR lumber will meet resistance in the higher-valued end product such as: horizontal truss chords and I-beams from parallel laminated veneer (PLV). PLV markets are developed on the basis that this product is a reliable lumber (solid wood) substitute in both size and grade that is unattainable from any other product and where price is less important. MSR lumber will be considered as a lower-valued engineered lumber product.

This data does not reflect the long-term future for MSR lumber. Every indication supports an expanding marketplace for this high-valued lumber product which can only mean continued growth. An association of MSR lumber producers has been established recently to promote their produce and lobby such groups as: Canada Mortgage and Housing Corp. for building code acceptance into non-traditional wood products. This trend throughout the building industry for an engineered product with a more reliable design performance specified by the building codes will further enhance the demand for MSR lumber.

4.8.3 Processing Equipment

The process of manufacturing MSR lumber requires the addition of MSR machinery and testing equipment to an existing planing mill. This will entail adding infeed conveyors from the trimmer and outfeed conveyors from the MSR system to the greenchain. Most planing mills are unable to provide the necessary floor space for the MSR line. Therefore, the investment analysis to produce MSR lumber will also include sufficient capital to modify the planing mill building.

The following list presents MSR equipment manufacturers:

- Computermatic - 113 installations in UK, Sweden, Australia and New Zealand;
- Metriguard - 26 installations in USA and Canada;
- Raute - 16 installations in Finland, Poland, UK an USSR;
- Cook Belinder - 4 installations in Scandinavia and Canada;
- Stres-O-Matic - 3 installations in USA, and
- Finnograder - 1 installation in Finland.

The identification process of potential MSR lumber is simple. Lumber passes through two bending sections. The rollers cause the lumber to be deflected or bent first downward by a fixed amount and then upward by nominally the same fixed amount. The forces required to achieve this bending are measured and then averaged together to provide a force measurement that is compensated for kink and bow in the piece. Before combining measurements in this way, the force measurement from the first bending section is delayed to correspond with the time it reaches the second bending section.

The compensated force is continuously measured as the lumber passes through the machine. Calibration assures that 1.0 volt representing compensated force is equivalent to 1.0 million psi Modulus of Elasticity (MOE). Two numbers, the

lowest value (Low Point E) and the average value (Average E) of MOE, are used to determine the machine grade for each piece of lumber. To meet the requirements for a particular MSR grade, the Average E value must be above the Average E threshold for that grade and simultaneously the Low Point E must be above the Low Point E threshold for the grade. The MSR machinery identifies each piece of lumber with a spray mark according to the machine grade for the piece.

The MSR grade stamp is applied manually by a visual grader who first determines if the piece meets the visual requirements for the grade identified by the machine mark. The visual grader can agree with the machine grade or he can downgrade the piece; in no case is he allowed to improve the grade above the machine grade. In addition, lumber produced by this machine/man combination must, on a sampling basis, meet off-line quality control tests for stiffness an strength.

4.8.4 Product Mix and Prices

In order to determine a value-added price differential for a VSR only product mix versus a MSR and VSR product mix, lumber price and product mix data was evaluated. Tables 19 and 20 summarize this information, respectively.

This analysis considered the value-added price differential for MSR lumber for a two-line sawmill processing random length dimension and stud lumber producing 20 MMbf annually. The value for the visual-graded product mix is $282.93 per Mbf KD, FOB Boston-CDN funds including a 15 percent excise tax. The value for the MSR product mix is $310.05 per Mbf based on the same lumber price criteria. Therefore, the value-added price differential for MSR lumber is $27.12 per Mbf. The product mix distribution for MSR lumber and the resulting lumber price decrease for the resulting remaining visual-graded lumber are important variables to this analysis. Therefore, sawmill producers interested in sorting and grading MSR lumber should consider this scenario as a prefeasibility evaluation only. It is recommended that a detail analysis be conducted in determining a value-added price differential for another specific set of mill parameters.

4.8.5 Production Costs

In quantifying the production costs of producing MSR lumber, a MSR line incorporated with an existing planing mill producing 20 MMbf per year was evaluated. Table 21 presents all production costs to operate this MSR/planing mill operation.

Capital investment includes all associated costs of purchasing, installation and peripheral costs such as: land, rolling stock and conveyors.

Variable labour costs may vary significantly depending upon equipment selection; however, for this investment analysis, 2 production employees as check graders were considered. An important aspect of producing MSR is quality control. Routine machinery maintenance, proof loading and equipment calibration is necessary. Therefore, a quality control supervisor was included in the investment analysis.

Table 19

Value for Visual-Graded Product Mix

Lumber Grade[1]	Lumber Price[2] ($ per Mbf)	Product Mix (%)	Lumber Value ($ per Mbf)
No. 2/Std and Better	330	30.6	100.98
No. 3 and Utility	260	14.4	37.44
Stud and Std and Better	275	47.5	130.63
Economy Stud and Utility	185	7.5	13.88
Average Product Mix Value		100.0	282.93

[1] Lumber grade distributions for a two-line sawmill producing random length dimension and stud lumber

[2] Based on Madison's Canadian Lumber Reporter; KD lumber prices, FOB mill - CDN funds including 15% excise tax.

Table 20

Value of Machine Stress-Rated Product Mix

Lumber Grade[1]	Lumber Price[2] ($ per Mbf)	Product Mix (%)	Lumber Value ($ per Mbf)
2400f-2.0E	445	7.4	32.73
2100f-1.8E	405	13.8	55.89
1650f-1.5E	380	21.0	79.80
No. 2/Std and Better	280	14.4	40.32
No. 3 and Utility	250	10.7	26.75
Stud and Std and Better	240	25.2	60.48
Economy Stud and Utility	185	7.5	13.88
Average Product Mix Value		100.0	310.05

[1]Lumber grade distributions for a two-line sawmill producing random length dimension and stud lumber.

[2]Based on Madison's Canadian Lumber Reporter; KD lumber prices, FOB mill - CDN funds including 15% excise tax.

Table 21

MSR Production Costs

Land Costs:	
. 1 acre at $5,000 per acre	$ 5,000
. depreciation at 10 percent	$ 500
Building Costs:	
. building 30' x 60' at $25 per ft²	$ 45,000
. depreciation at 10 percent	$ 4,500
Capital Costs[1]**:**	
. MSR machinery and testing equipment	$300,000
. additional conveyors	$100,000
. automatic stacker	$ 50,000
. installation of equipment	$ 50,000
. depreciation at 20 percent	$100,000
Variable Costs:	
. 2 check graders at $8.10 per hour	$ 35,000
. 1 quality control supervisor	$ 40,000
. indirect labour benefits at 20 percent	$ 22,000
. calibration	$ 20,000
. power and fuel	$ 10,000
Fixed Manufacturing Costs:	
. maintenance supplies	$ 50,000
. packaging and shipping materials	$ 20,000
. shop sundry	$ 10,000
Overhead Costs:	
. administration, insurance, etc.	$ 60,000
. contingency	$ 50,000

[1] Irvington-Moore Metriguard (U.S.A.)

4.8.6 Investment Analysis

An investment analysis was conducted for a MSR plant based on a value-added price differential of $27.12 per Mbf, a sawmill production of 20 MMbf annually and the production costs outlined in Table 21.

The internal rate of return for the MSR investment is 38.1 percent with a payback period of 1.4 years. The after tax profit margin in the first year without considering any investment tax credits is $72,240 or 17.2 percent based on a total production cost of $422,000 and a combined federal and provincial tax rate of 40 percent.

Table 22 outlines the sensitivity of this analysis for the major operating parameters. The MSR investment is able to withstand a 20 percent drop in sales or product price and still maintain an above marginal internal rate of return of 20.8 percent. A similar increase or decrease of the other production costs of variable labour, fixed manufacturing or overhead cost will result in a smaller impact on the profit margin.

4.8.7 Summary

In summary, a MSR investment is an attractive value-added opportunity for the following reasons:

- MSR lumber is a consumer-accepted product with an expanding market potential;
- the manufacturing process is simplicitic in that MSR machinery and testing equipment can be easily incorporated into the material flow of an existing planing mill;
- a MSR investment is economically viable since it can profitably resist a 20 percent market slump, and
- MSR lumber can be manufactured by finger-jointing MSR rejects and low-valued and short lumber.

Interested sawmill companies are encouraged to investigate the feasibility of MSR lumber in greater detail for their own specific operational, financial and market constraints. A mill should evaluate the following important variables which will ultimately determine the economics of a MSR operation:

- MSR and VSR strength and grade distributions for mill-run lumber;
- the impact of sorting MSR lumber on VSR lumber prices;
- marketability of VSR lumber considering its reduced lumber quality;
- detailed market survey of MSR clients in the truss industry and wholesale commodity brokers;
- characterization of MSR rejects and low-valued and short length lumber for finger-jointed MSR lumber, and
- investment feasibility of finger-jointed MSR lumber.

Table 22

Sensitivity Analysis for MSR Investment

Operating Parameter	Percent Change of Operating Parameter 80	90	100	110	120
	..... internal rates of return				
Value-Added Price Differential	20.8	30.0	38.1	45.7	52.9
Variable Labour Cost	41.7	39.9	38.1	36.3	34.4
Fixed Manufacturing Cost	43.5	40.8	38.1	35.4	32.5
Facilities Cost	46.0	41.7	38.1	35.1	32.6

4.9 Dimension Stock Plant

4.9.1 Introduction

The furniture industry has for the most part utilized hardwood species and some pine. However, as a result of declining supply of quality hardwoods and increasing resource costs, there has been species substitution of traditional hardwood products. Much of this species interchange has taken place in medium-price furniture where significant volumes of composite board products (with plastic or wood overlays) and softwood lumber (ponderosa, jack and lodgepole pine) have been increasing in the past two decades.

There has also been added pressures of rising manufacturing costs domestically and severe marketing competition from Sweden and third world countries to supply the low and medium-price furniture sectors. The North American furniture industry is in a state of change and seeking every cost advantage to remain viable. One such cost-cutting measure has been a recent trend for the furniture industry to utilize standarized dimension stock components in the manufacturing of their product lines. Coupled with the cost-saving move toward increased utilization of softwood lumber, there appears to be a real possibility for softwood furniture components.

SPF dimension stock is currently being used by the North American furniture industry; however, this market is small. Therefore, an integrated dimension stock plant with a sawmill company would need to supplement its resource supply with white pine and some hardwood lumber. This situation would place the dimension stock plant in a much more flexible position, as well as, increase its product value.

4.9.2 Market Potential

Some furniture manufacturing operations purchase rough dry lumber and produce their own dimension stock components while others purchase components as their raw material. The traditional species used in furniture are; oak, yellow birch, hard maple and white pine.

The supply of high quality lumber for these species has increased the price of furniture significantly in recent years. This present price structure has allowed less traditional species and products to enter the market. Other species such as; white birch, poplar, soft maple, beech and softwoods have gained popularity in the furniture marketplace. Furthermore, new products such as; medium density fiber board overlaid with veneer of traditional hardwoods and melamine have also served as substitutes in the manufacturing of furniture and furniture components.

Marketing of dimension components is usually arranged through long term commitments between the manufacturer and furniture customer. The dimension component manufacturer identifies a product mix that is best suited for his plant and species mix. The most important considerations that must be successfully achieved by a dimension component manufacturer are:

- price;
- quality, and
- product supply reliability.

Table 23

Value of Materials for Canadian Wooden Furniture

Type of Furniture	Year 1982	1983	1984
	. . . millions of dollars . . .		
Household Furniture			
. softwoods	20	32	34
. hardwoods	46	40	41
. framestock[1]	40	49	55
Office Furniture			
. softwoods	5	5	6
. hardwoods	9	8	8
. framestock	4	5	6
Miscellaneous Furniture[2]			
. softwoods	11	15	18
. hardwoods	11	17	18
. framestock	9	11	12

[1] Includes $6, $11 and $11 million dollars of furniture components for 1982, 1983 and 1984, respectively.

[2] Other furniture and fixtures, institution furniture and bedspring and mattress companies.

Source: Statistics Canada Cat. No. 35-216 (1984 current edition).

Market information for the furniture industry is not readily available with respect to species nor solid wood only shipments. However, Table 23 outlines the value of materials from Statistics Canada for the following sectors of the furniture industry:

- household furniture;
- office furniture, and
- miscellaneous furniture.

Although the majority of the furniture is produced from hardwoods, softwood lumber totalled $58 millions compared to $67 million for hardwood lumber in 1984 (excluding framestock). Softwood lumber does enjoy a sizable share in the furniture market attributed mostly to white pine.

These marketing statistics show only steady growth for Canadian furniture offering little opportunity to enter this market. The only exception is framestock or bedstock with its 18.8 percent growth. This product produced from both hardwoods and softwoods is required by the furniture industry. Our furniture industry is primarily located in Quebec, Ontario and the northeastern United States. Therefore, the market potential for a softwood sawmill able to produce cut-to-length framestock will depend greatly upon the cost of transportation to these market places.

Canadian furniture manufacturers and dimension stock component producers have been successful over the past several years in exporting to the United States. Table 24 provides information concerning U.S. imports of wood furniture and parts as compiled from U.S. statistics of the U.S. Department of Commerce. Canada has been second to only Taiwan while maintaining a 12 percent growth rate of the largest and most competitive furniture market in the world. While the other countries have not fared very well, Canada has been able to expand its market share to an estimated 12.9 percent in 1987.

Despite this optimistic information, free trade has dampened the outlook for the Canadian furniture industry. The larger furniture companies in the U.S. have production efficiency over our Canadian counterparts. Furthermore, the Canadian industry is protected by a 13.0 to 16.0 percent tariff levied on imports while the U.S. tariffs are only 2.5 to 6.6 percent. The immediate future for the Canadian furniture industry does not appear bright unless tariffs are dropped slowly over the course of many years. This market should not be ignored on the basis of free trade since our furniture manufacturers have closer proximity to both the Canadian and American markets. The Canadian furniture industry should strengthen over time creating excellent value-added opportunities for softwood lumber.

The best value-added product for softwood lumber is ready-to-assembly (RTA) furniture. This type of furniture is generally manufactured from lodgepole pine and has recently spread to the utilization of jack pine. There is no reason why RTA furniture could not expand to include clear SPF dimension stock components.

Table 24

U.S. Imports of Wooden Furniture and Parts

Country	Year 1982	1983	1984	1985	1986	1987[1]
	. . . millions of dollars . . .					
Taiwan	151	224	291	396	559	666
Canada	79	104	150	191	231	265
Italy	34	47	84	141	187	187
Denmark	77	104	157	181	172	147
Others	318	387	507	671	737	782
Total	659	866	1,189	1,580	1,886	2,047

[1]Projected import values based on first 8 months.

Source: Wood and Wood Products, December 1987.

Some RTA furniture is manufactured from glued-up solid wood panels components (generally clear of knots) with the majority produced from particle board, fiberboard or MDF with paper, melamine or veneer laminates. SPF lumber would require manufacturing and marketing research as to the following important variables:

- production costs;
- product quality, and
- consumer acceptability.

The importance of RTA furniture to SPF lumber is significant as demonstrated by the Canadian and American RTA furniture sales presented in Table 25. Currently, the market size is $750 and $125 million dollars in the U.S. and Canada. This market has been estimated to double by 1990 as projected by a survey conducted by the research deparment of Wood and Wood Products.

RTA furniture sales are approximately 4 and 12 percent in the U.S. and Canada while this market segment has obtained 40 percent of all European furniture sales. Considering the size of the North American market compared to the European market percentage, RTA is an exploding market. The commercial significance of SPF lumber able to satisfy the manufacturing and marketing requirements for acceptance as a high-valued RTA furniture or furniture component is overwhelming.

4.9.3 Plant Capacity and Description

For a sawmill company integrating forward to a dimension component plant, the optimum plant size is 3.5 million board feet of raw material volume annually. It is recommended to start at a small-sized plant so as to minimize initial management problems.

A conventionally-equipped plant processing 3.5 MMbf of dry lumber per year is based on the following operating constraints:

- 2 cut-off saws;
- 4 ripsaws;
- 1 salvage ripsaw;
- 3.2 Mbf lumber capacity per ripsaw per shift;
- 50 percent production capacity at each main ripsaw;
- 71 percent dimension stock yield assuming 5 percent lumber waste at the cut-off saws and 25 percent lumber waste at the ripsaws, and
- 240 shifts annually.

Therefore, the dimension stock plant production of furniture and kitchen cabinet components and edge-glued panels is 2.5 million board feet annually.

Table 25

Canadian and U.S. RTA Furniture Sales

Country	Year 1980	1983	1986	1990[1]
	. . . millions of dollars . . .			
United States	300	550	750	1,500
Canada	40	85	125	150

[1]Projected

Source: Wood and Wood Products, May 1987.

4.9.4 Raw Material

Assuming that a 20 million board foot sawmill has a species mix of 85 percent SPF and 15 percent white pine, the dimension stock plant will process the following lumber mix:

- 1.7 MMbf of No. 3 Common and Better white pine based on a 57 percent yield;
- 0.9 MMbf of Utility and Better SPF, and
- 0.9 MMbf of No. 1 Common and Better, high-valued hardwoods such as; oak, yellow birch and hard maple.

The lumber volume of white pine (51.4 percent) was maximized for the raw material species mix in order to maximize the value-added product value of furniture components. The remaining lumber requirements were equally distributed for SPF and hardwood lumber. Since, the major objective of this report is to determine viable marketing and manufacturing opportunities for softwood lumber, softwood components were considered even though hardwood components have a higher selling price. The decision to manufacture softwood components should prove profitable when one considers the poor lumber prices for short and small dimension softwood lumber, as well as, present furniture trends away from traditional hardwoods.

The resulting weighted raw material lumber cost is as follows:

. white pine	48.6%	x	$ 530	per Mbf
. spruce-pine-fir	25.7%	x	$ 280	per Mbf
. hardwoods	25.7%	x	$ 800	per Mbf
. raw material cost			$ 535	per Mbf

All prices are for kiln-dried lumber FOB dimension plant CDN funds. The white pine and SPF lumber prices include a $20 material handling cost instead of a transportation cost for lumber delivery. The hardwood lumber price includes a $40 transpsortation cost for purchasing delivered lumber on the open market. Appendix XI presents the detailed costing calculations for the average prices used for each species in determining the weighted raw material cost.

The average weighted raw material cost for a dimension stock plant processing the above product mix of white pine, SPF and hardwoods is $535 per Mbf-lumber FOB dimension plant CDN funds.

4.9.5 Dimension Stock Components

Typical dimension stock components are summarized by the following:

(i) rough solid;
(ii) glued-up panels;
(iii) rough squares;
(iv) bending stock;
(v) rails, and
(vi) frame stock.

(i) Rough Solid

- 4/4, 5/4, 6/4 and 8/4 thick parts
- random width and length
- KD No. 2 Common and Better and Standard and Better

(ii) Glued-up Panels

- 4/4, 5/4, 6/4 and 8/4 thick panels sizes of 15, 18, 20, 24 and 30 in. square 18 x 30 in., 18 x 48 in., 24 x 30 in.,24 x 36 in. and 24 x 48 in. most commonly.
- KD dressed and clear panels for hardwoods and KD dressed and either clear or knotty for white pine and softwoods.

(iii) Rough Squares

- generally hardwood and white pine 2, 2 1/2, 3 and 4 in. squares in lengths of 10 to 48 in.
- KD clear or No. 1 Common or Better.

(iv) Bending Stock

- 4/4 thick hardwoods parts
- dimensions of 4 x 18 in. and 6 x 26 in.
- AD or KD, rough and clear components.

(v) Rails

- 4/4 thick hardwood and white pine parts
- 1 x 3 x 18 to 80 in. in multiples of 6 in., 3 1/2 and 5 1/2 x 24 and 80 in.
- KD, dressed and cut-to-size No. 2 Common and Better.

(vi) Frame Stock

- 4/4 thick hardwood and softwood parts
- 1 1/2 to 4 in. widths in lengths of 18 to 96 in.
- KD, dressed and cut-to-size No. 3A Common and Better for hardwoods and Utility and Better for softwoods.

4.9.6 Dimension Stock Prices

Dimension stock components are priced for each specific order depending upon quantity, species, size and grade. Table 26 presents average dimension prices surveyed from several component plants throughout eastern Canada and United States.

The resulting weighted product value is as follows:

. white pine	48.6% x	$2,250 per Mbf
. spruce-pine-fir	25.7% x	$ 460 per Mbf
. maple and birch	15.4% x	$2,500 per Mbf
. oak	10.3% x	$3,750 per Mbf
. average product value		$1,983 per Mbf

The average weighted dimension component product value is approximately $1,983 per Mbf FOB dimension plant CDN funds based on the same lumber species distribution as outlined in the raw material section.

4.9.7 Processing Equipment and Production Costs

A modern traditional dimension stock plant was selected to determine the feasibility of this value-added opportunity. Table 27 outlines the production costs and processing equipment required to produce dimension stock components. The size of this plant was based on several operating constraints previously mentioned in the section of plant capacity and description.

The total capital investment or facilities cost for a dimension component plant is calculated at $2,707,000 including land, buildings, processing equipment, rolling stock, machinery installation and working capital.

The total operating cost for this capital investment is $1,802,000 including variable labour and indirect benefits, utilities and fuel, fixed manufacturing costs, depreciation and overhead costs.

Table 26

Dimension Stock Component Prices[1]

Dimension Stock Product	Species			
	SPF[2]	White Pine[3]	Maple & Birch[3]	Oak[3]
Rough Solid (1 x 2 1/2 x 30 in.)	$620	$2,250	$2,500	$3,750
Glued-up Panels (1 x 18 x 48 in.)	n/a	$1,500	$1,700	$3,200
Rough Squares (2 x 2 x 24 in.)	$620	$3,400	$3,750	$5,600
Bending Stock (1 x 4 x 18 in.)	n/a	n/a	$2,750	n/a
Rails (1 x 3 x 60 in.)	n/a	$2,900	$2,900	n/a
Frame Stock (kiln-dried lumber)	$300	n/a	$ 375	n/a

[1]Kiln-dried dimension stock component prices in $ per Mbf FOB dimension stock plant CDN funds.

[2]Lodgepole pine employed in KD furniture manufactured for Ikea and Sears.

[3]Traditional dimension stock species utilized in hardwood furniture and kitchen cabinets.

n/a
(not applicable)

Table 27

Dimension Plant Production Costs

Land Costs:	
. 1 acre at $5,000 per acre	$ 5,000
. depreciation at 10 percent	$ 500
Building Costs:	
. dry storage building of 100' x 100' at $15 per ft^2 for rough lumber and inventory	$ 150,000
. dimension stock building of 150'x 150' at $70 per ft^2 complete with offices, heating, plumbing, electrical, humidification, dust collection, compressed air and sprinkler systems.	$1,575,000
. depreciation at 10 percent	$ 172,500
Equipment Costs:	
. rough planer	$ 75,000
. cross-cut saws (2) with backgauges	$ 50,000
. ripsaws (4) with light guides	$ 70,000
. salvage cross-cut saw	$ 25,000
. salvage ripsaw	$ 30,000
. material handling equipment	$ 100,000
. chipper and residue system	$ 75,000
. edging saw	$ 30,000
. matching saw	$ 25,000
. abrasive planer	$ 100,000
. RF gluer	$ 50,000
. clamp carrier	$ 40,000
. panel and component double-end trimsaw	$ 50,000
. front-end loader	$ 125,000
. depreciation at 20 percent	$ 169,000
. installation of equipment	$ 100,000
Variable Costs:	
. 25 employees at $8.00 per hour	$ 432,000
. 1 foreman at $10.00 per hour	$ 21,600
. 1 supervisor at $17.00 per hour	$ 39,800
. indirect labour benefits at 20 percent	$ 98,600
. utilities and fuel	$ 100,000
. selling expense at 6 percent of sales	$ 242,600
Fixed Manufacturing Costs:	
. maintenance and supplies	$ 75,000
. packaging and shipping materials	$ 25,000
. shop sundry	$ 25,000
Overhead Costs:	
. general manager	$ 75,000
. administration, insurance, etc.	$ 225,000
. contingency	$ 100,000

4.9.8 Investment Analysis

An investment analysis for a dimension stock plant was conducted on the basis of the product volumes and values and production costs determined in previous sections. The internal rate of return (IRR) for this capital investment is a healthy 40.1 percent with a payback period of 2.5 years.

Table 28 outlines the sensitivity of this analysis for the major operating parameters. The proposed dimension stock plant investment shows a 26.5 percent IRR for a 20 percent reduction in sales volume from a lower than expected production volume or sales price. This value-added opportunity is also attractive from this point of view based on its high inherent level of resiliency. Furthermore, this capital investment is able to economically withstand a 20 percent decrease in product price at an IRR of 15.2 percent.

As a result of the dimension stock plant's excellent IRR, the investment analysis determined the following breakeven operating levels:

- product price - $1,544 per Mbf - product tally;
- sales volume - 1.946 MMbf - product tally; and
- facilities cost - $5,866,500

The breakeven operating levels were based on an IRR of 12 percent and an effective tax rate of 40 percent combined for both federal and provincial taxes.

4.9.9 Summary

In summary, this excellent value-added opportunity does carry some element of warning. As with any investment requiring a significant initial capital, there exists a corresponding risk factor with an increase in facilities cost. An investor must evaluate the dimension stock component plant's attractive profitability against its high facilities cost and associated potential risk.

Table 28

Sensitivity Analysis for a Dimension
Stock Plant Investment

Operating Parameter	Percent Change of Operating Parameter				
	80	90	100	110	120
	. . . internal rates of return . . .				
Sales	26.5	33.5	40.1	46.4	52.5
Price	15.2	28.5	40.1	51.0	61.5
Variable Cost	54.6	47.4	40.1	32.6	24.7
Fixed Manufacturing Cost	42.7	41.4	40.1	38.8	37.4
Facilities Cost	48.2	43.8	40.1	37.0	34.3

APPENDIX I

SOFTWOOD LUMBER PRICES

SOFTWOOD LUMBER PRICES[1]

Product Mix	Dimension Lumber	Stud Lumber
1x3	230	200
1x4	240	210
1x5	265	220
1x6	265	220
2x3	250	230
2x4	300	260
2x5	310	-
2x6	330	280
2x7	335	-
2x8	350	-
2x10	400	-
Cants	300	265

[1] Rough, green mill-run lumber price $ per Mbf FOB sawmill - CDN funds

APPENDIX II

GROSS MONETARY BENEFITS BY IMPROVING PRODUCT MIX

GROSS MONETARY BENEFITS BY IMPROVING PRODUCT MIX

Variables per Shift	Dimension Mill	Stud Mill
Present lumber production	35 Mbf	35 Mbf
Present log productivity	1000 logs	5270 logs
Present lumber recovery	47.0%	45.0%
Net sawlog volume	6.31 cf/log	2.20 cf/log
Improved log productivity	1200 logs	6324 logs
Improved lumber recovery	50.0%	46.5%
Improved lumber production	45 Mbf	77 Mbf
Incremental lumber increase	10 Mbf	42 Mbf
Average product value	$310/Mbf	$255/Mbf
Gross Monetary Benefits at 240 Shifts Annually	$744,000	$2,570,400

APPENDIX III

GROSS PROFIT MARGINS FOR LUMBER VOLUME AND VALUE IMPROVEMENTS

GROSS PROFIT MARGINS FOR LUMBER VOLUME AND VALUE IMPROVEMENTS

LUMBER VOLUME IMPROVEMENT (%)	LUMBER VALUE IMPROVEMENT (%)					
	0	1	3	5	7	10
0	25.0	26.1	28.4	30.7	33.0	36.5
1	25.9	27.1	29.5	31.8	34.1	37.7
3	28.0	29.2	31.6	34.0	36.3	39.9
5	30.0	31.2	33.7	36.1	38.5	42.2
7	32.1	33.3	35.7	38.3	40.7	44.4
10	35.1	36.4	38.9	41.5	44.0	47.9

APPENDIX IV

GROSS PROFIT MARGINS FOR LUMBER VOLUME AND VALUE DECLINES

GROSS PROFIT MARGINS FOR LUMBER VOLUME AND VALUE DECLINES

LUMBER VOLUME DECLINE (%)	LUMBER VALUE DECLINE (%) 0	1	3	5	7	10
0	25.0	23.8	21.4	19.1	16.8	13.3
1	23.9	22.8	20.5	18.2	15.9	12.4
3	21.9	20.7	18.5	16.2	14.0	10.6
5	19.8	18.7	16.5	14.3	12.1	8.8
7	17.8	16.7	14.6	12.4	10.2	7.0
10	14.7	13.7	11.6	9.5	7.4	4.3

APPENDIX V

VALUE-ADDED PRICE DIFFERENTIAL FOR DRY KILNS

VALUE-ADDED PRICE DIFFERENTIAL FOR DRY KILNS

I - STUD LUMBER

Lumber prices from random length for 2x4x8 and 2x6x8 studs PET Boston FOB mill US funds.

US/CDN funds exchange rate of 1.30

2x4 studs dry - $242 (US) x 1.30 = $315 (CDN)

2x4 studs green - $229 (US) x 1.30 = $298 (CDN)

$17 per Mbf

2x6 studs dry - $290 (US) x 1.30 = $377 (CDN)

2x6 studs green - $261 (US) x 1.30 = $339 (CDN)

$38 per Mbf

Assume 60% 2x4 studs and 40% 2x6 studs of the 5 MMbf annual stud production.

Therefore, weighted average value-added green to dry price differential for studs is $25.40 per Mbf.

II - SHORT LUMBER

Value-added for short lumber (less than 8 feet in length) is only in reducing the inventory cost from 8 weeks of air drying to 2 weeks of kiln drying.

Kiln dried short lumber will not fetch a higher sales price than $180 per Mbf.

Interest bank rate for inventory carrying cost is 12 percent.

Therefore, inventory saving = $\frac{\$180}{\text{Mbf}} \times 4 \text{ MMbf} \times \frac{8 - 2 \text{ weeks}}{50 \text{ weeks}} \times 12\%$

= $2.60 per Mbf

III - WHITE PINE LUMBER

Value added for No. 3 Common and Better of $135 per Mbf is based on recent SIP studies and a following grade yield:

- 4/4 lumber - 50 percent;
- 6/4 lumber - 20 percent; and
- 8/4 lumber - 30 percent.

Scenario A

45.4% studs	x	$25.40	=	$11.53
36.4% shorts	x	$ 2.60	=	$ 0.95
18.2% WP	x	$135.00	=	$24.57
Gross value-added price				$37.05
Less 2 percent for degrade[1]				$ 6.11
Net value-added price				$30.94

Scenario B

71.4% studs	x	$25.40	=	$18.14
28.6% WP	x	$135.00	=	$38.61
Gross value-added price				$56.75
Less 2 percent for degrade[1]				$ 7.55
Net value-added price				$49.20

[1] Based on a 2 percent lumber degrade on the green lumber price.

APPENDIX VI

CAPITAL COSTS FOR SCENARIO A

CAPITAL COSTS FOR SCENARIO A

I - Cost of Drying Facilities

a) Conventional-Residue	Conventional steam-heated kilns and residue-fired boiler: three prefabricated aluminum, side loading kilns with a total capacity of 125 Mbf with adjoining boiler and control room. Boiler: output rated at approximately 7.0×10^6 BTU's/hr. Boiler cost includes all residue handling equipment and residue storage facilities.	
Total Installed Cost		$ 800,000
b) Dehumidification	Four prefabricated aluminum side-loading kilns with a total capacity of 165 MBM complete with all dehumidification equipment, adjoining control room and electric boiler used for the production of steam for stress relief in the White Pine lumber.	
Total Installed Cost		$ 710,000
Stacker and Unstacker		$ 100,000
Sheds for Storage of Dry Lumber		$ 20,000
Stickers and Bunks		$ 5,000

II - Equipment Overhaul or Replacement after 5 years

. Conventional-Residue	$ 64,750
. Dehumidification	$ 58,450

III - Working Capital

Average volume of lumber in inventory as a percent of annual volume dried (analysis establishes value)	6 percent

APPENDIX VII

OPERATING COSTS FOR SCENARIO A

OPERATING COSTS FOR SCENARIO A

I - Energy Required for Drying 11 MMbf per Year

. Conventional Residue Kilns Energy Cost $3.22/Mbf	$ 35,420/year
. Dehumidifier Kilns Energy Cost $13.63/Mbf	$149,930/year

II - Labour Including Fringe Benefits

. Conventional Residue

- lumber stackers (2 employees)	$2.62/Mbf
- kiln operation (including boiler supervision)	$2.62/Mbf
- loading, unloading and handling	$0.17/Mbf
Total Cost	$59,510/year

. Dehumidification

- lumber stackers (1 employee)	$1.31/Mbf
- kiln operation (1 employee)	$2.62/Mbf
- loading, unloading & handling	$0.13/Mbf
Total Labour Cost	$44,660/year

III - Overhead

a) Maintenance of equipment and facilities at 5% of pre-installed cost.

. Conventional Residue	$2.94/Mbf
. Dehumidification	$2.66/Mbf

b) Taxes and insurance at 2% of installed facilities cost.

. Conventional Residue	$1.68/Mbf
. Dehumidification	$1.52/Mbf

c) Office and management (both systems)	$0.33/Mbf

Total Overhead

. Conventional Residue ($4.95/Mbf)	$54,450/year
. Dehumidification ($4.51/Mbf)	$49,610/year

IV - Opportunity Cost of Carrying Three Times the Kiln Capacity in Daily Inventory

Using an average weighted market value of products to be dried of $305.63/Mbf green.

Carrying cost rate of 14%.

Total Cost

. Conventional Residue	$16,012/year
. Dehumidification	$21,127/year

APPENDIX VIII

CAPITAL COSTS FOR SCENARIO B

CAPITAL COSTS FOR SCENARIO B

I - Cost of Drying Facilities

. Conventional-Residue	Conventional steam heated kilns and residue-fired boiler: three prefabricated aluminum, side loading kilns with a total capacity of 100 Mbf with adjoining boiler and control room. Boiler: output rated at approximately 6.5×10^6 BTU's/hr. Boiler cost includes all residue handling equipment and residue storage facilities.	
Total Installed Cost		$ 675,000
Stacker and Unstacker		$ 80,000
Sheds for Storage of Dry Lumber		$ 14,000
Stickers and Bunks		$ 3,000

II - Equipment Overhaul or Replacement after 5 years

. Conventional-Residue System	$ 52,850

III - Working Capital

Average volume of lumber in inventory as a percent of annual volume dried (analysis establishes value)	6 percent

APPENDIX IX

OPERATING COSTS FOR SCENARIO B

OPERATING COSTS FOR SCENARIO B

I - Energy Required for Drying 7 MMbf per Year

. Conventional Residue System
Energy Cost $3.92/Mbf — $ 27,440/year

II - Labour Including Fringe Benefits

. Conventional Residue System

- lumber stackers	$2.06/Mbf
- kiln operation (including boiler supervision)	$4.11/Mbf
- loading, unloading and handling	$0.22/Mbf
Total Labour Cost	$44,730/year

III - Overhead

a) Maintenance of equipment and facilities at 5% of pre-installed cost.

. Conventional Residue — $3.86/Mbf

b) Taxes and insurance at 2% of installed facilities cost.

. Conventional Residue — $2.21/Mbf

c) Office and management (both systems) — $0.39/Mbf
Total Overhead ($6.46/Mbf) — $45,220/year

IV - Opportunity Cost of Carrying Three Times the Kiln Capacity in Daily Inventory

Using an average weighted market value of products to be dried of $377.49/Mbf green.

Carrying cost rate of 14%.
Total Cost — $15,855/year

APPENDIX X

RAW MATERIAL COST DETERMINATION FOR A PROPOSED REMANUFACTURING PLANT

RAW MATERIAL COST DETERMINATION
FOR A PROPOSED REMANUFACTURING PLANT

1) White Pine (KD No. 3 Common and Better and AD No. 4 and Common)

4/4 - 70% x	$480 per Mbf
6/4 - 20% x	$525 per Mbf
8/4 - 10% x	$560 per Mbf
Total	$497 per Mbf FOB mill CDN funds

2) Spruce-Pine-Fir (KD shorts)

$207 per Mbf FOB plant CDN funds

3) Hardwoods (KD No. 1 Common and Better)

Red Oak 4/4	- 80% x	$1,050 per Mbf
Yellow Birch 4/4	- 10% x	$ 590 per Mbf
Hard Maple 4/4	- 10% x	$ 540 per Mbf
Raw Material Cost		$ 760 per Mbf FOB mill CDN funds

APPENDIX XI

RAW MATERIAL COST DETERMINATION FOR A PROPOSED DIMENSION STOCK PLANT

RAW MATERIAL COST DETERMINATION
FOR A PROPOSED DIMENSION STOCK PLANT

1) White Pine (KD No. 3 Common and Better)

4/4	-	70%	x	$555	per Mbf
6/4	-	20%	x	$580	per Mbf
8/4	-	10%	x	$600	per Mbf

Total $510 per Mbf FOB plant CDN funds

2) Spruce - Pine - Fir (KD Utility and Better)

Std. and Btr. 1 x 3 to 6 in.	-	70%	x	$260	per Mbf
Utility 1 x 3 to 6 in.	-	30%	x	$230	per Mbf

Total $250 per Mbf
FOB plant CDN funds

3) Hardwoods (KD No. 1 Common and Better)

Red Oak 4/4	-	40%	x	$1,050	per Mbf
Yellow Birch 4/4	-	30%	x	$ 590	per Mbf
Hard Maple 4/4	-	30%	x	$ 540	per Mbf

Total $ 760 per Mbf
FOB plant CDN funds